WOODWORKS

NOVEMBER 13TH 2019

Integrating Passive House into Everyday Enclosure Design

-Presented by Dan Whitmore, CPHC, CPHB
RDH Building Science


Photo: Thorsten Chlupp
Karuna Foundation

RDH

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

PASSIVE HOUSE CONSULTING & CERTIFICATION

RESEARCH & EDUCATION

NET ZERO

RDH

Making Buildings Better™

FAÇADE ENGINEERING

HISTORIC REHABILITATION

ENERGY & IAQ MONITORING

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Course Description

To some design and construction professionals, the term ‘passive house’ carries connotations of added expense, difficult details and super-thick walls and roofs. However, for larger scale multi-family and commercial buildings, the concepts of passive house design can be easily implemented with a proper understanding of the core principles and guiding design techniques. Passive house can provide deep operational energy reductions through its core principles of entire building air tightness, minimal thermal bridging, and a balanced and appropriately-sized mechanical ventilation system. This webinar will draw on these guiding principles to illustrate how passive house concepts can be integrated into a number of wood-frame project types—including mid-rise multi-family, low-rise commercial, and tall wood buildings. Enclosure detailing techniques, construction cost impacts, and energy savings potential will be illustrated with an emphasis on repeatable and scalable strategies.

Learning Objectives

1. Review the basic principles of passive house design and discuss unique aspects that arise when implementing this technique in larger, multi-family projects.

2. Highlight benefits associated with the use of wood framing in multi-family and commercial passive house projects.

3. Demonstrate successful detailing options for walls and roofs in wood-frame projects with an emphasis on air tightness and insulation continuity.

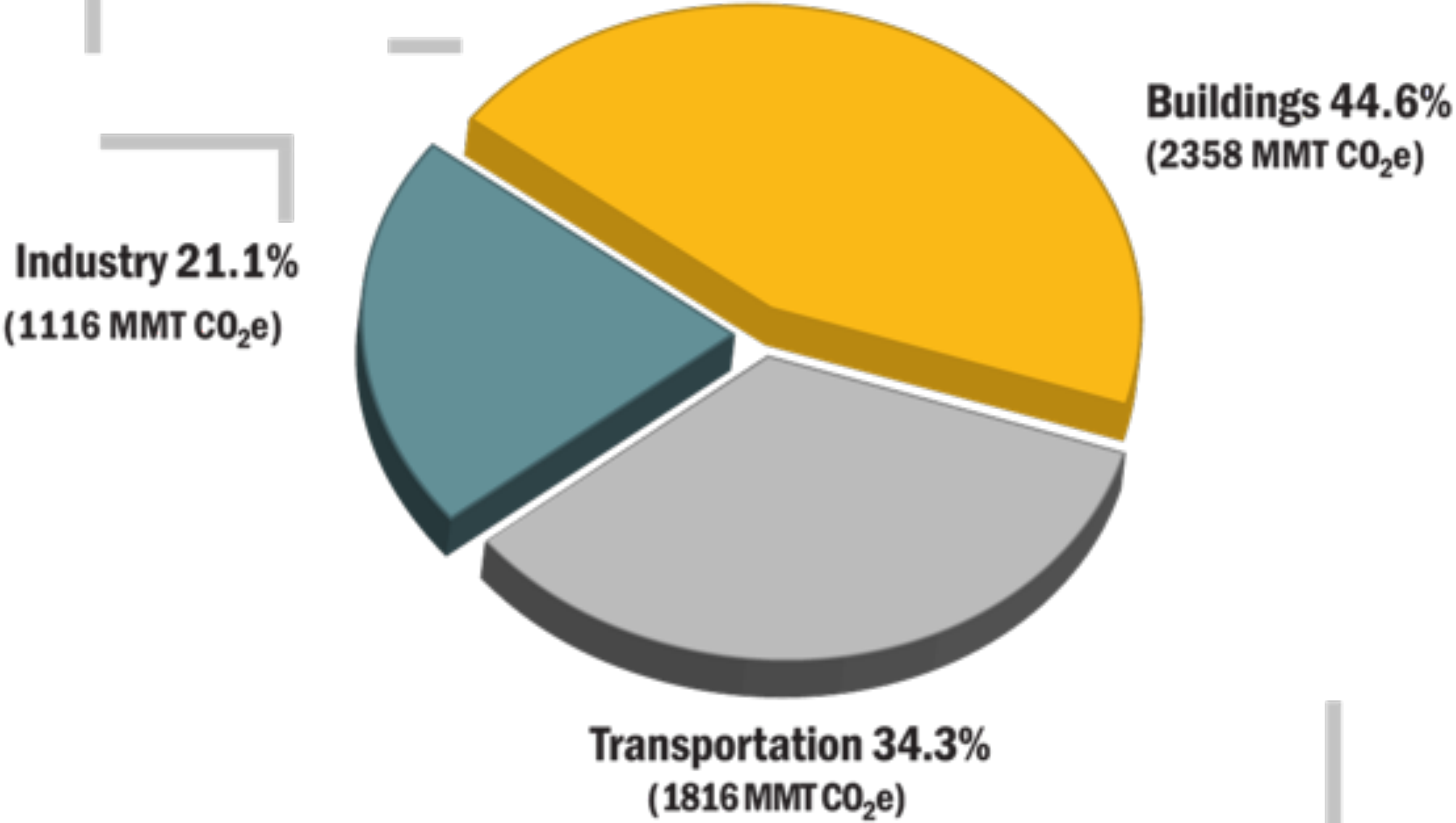
4. Discuss design guidelines for future implementation of low-energy projects in cold climates with the possibility of cost competitiveness with traditional project types.

Photo: NASA

"Here is one of the few effective keys to the Design problem:
The ability of the Designer to recognise as many of the constraints as possible;
his (*or her*) willingness and enthusiasm for working within these constraints."
-Charles Eames

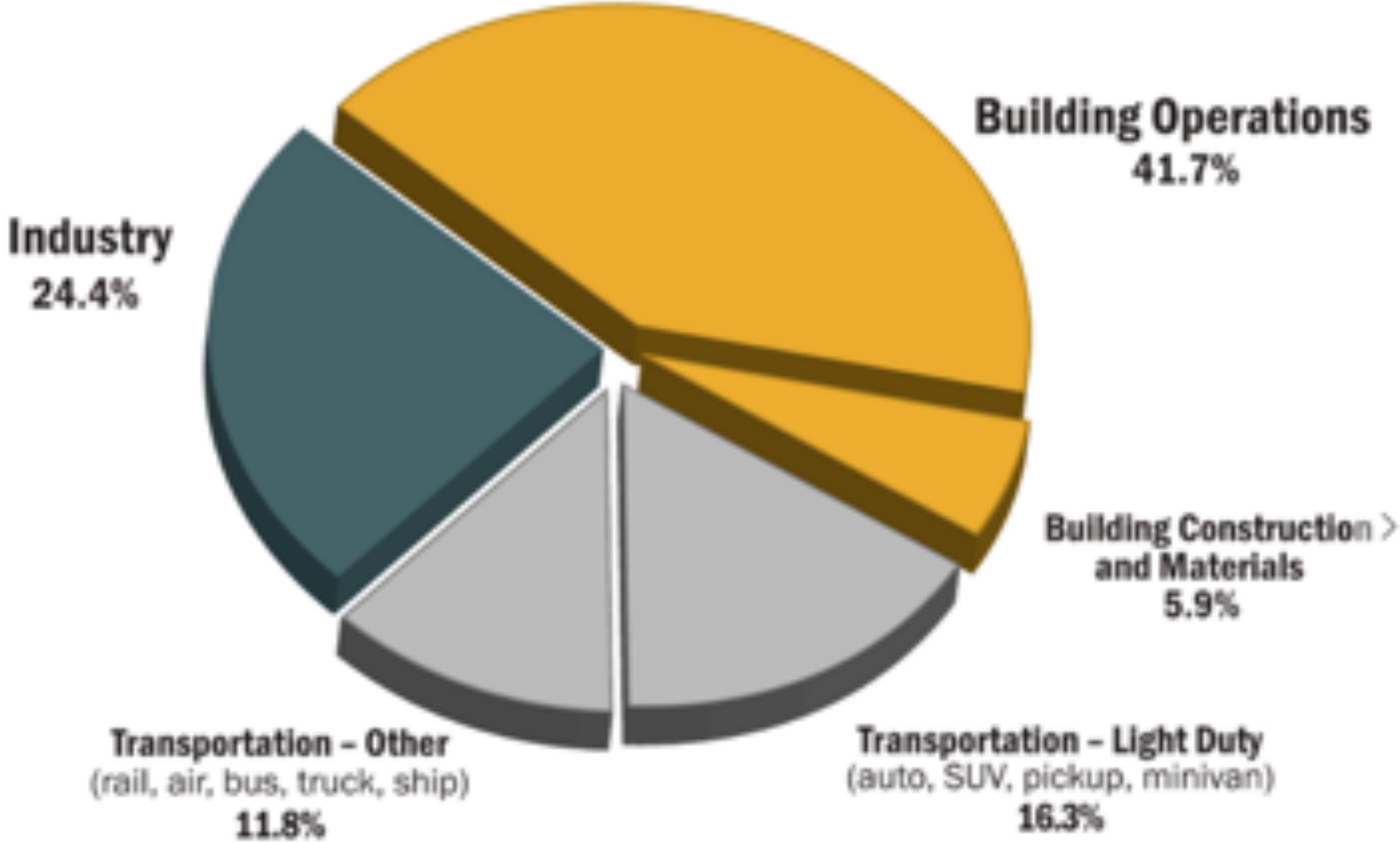
Photo: NASA


Photo: Jeremy Bitterman Photography
Architect: Holst Architecture
Contractor: Hammer and Hand



U.S. CO_2 Emissions by Sector

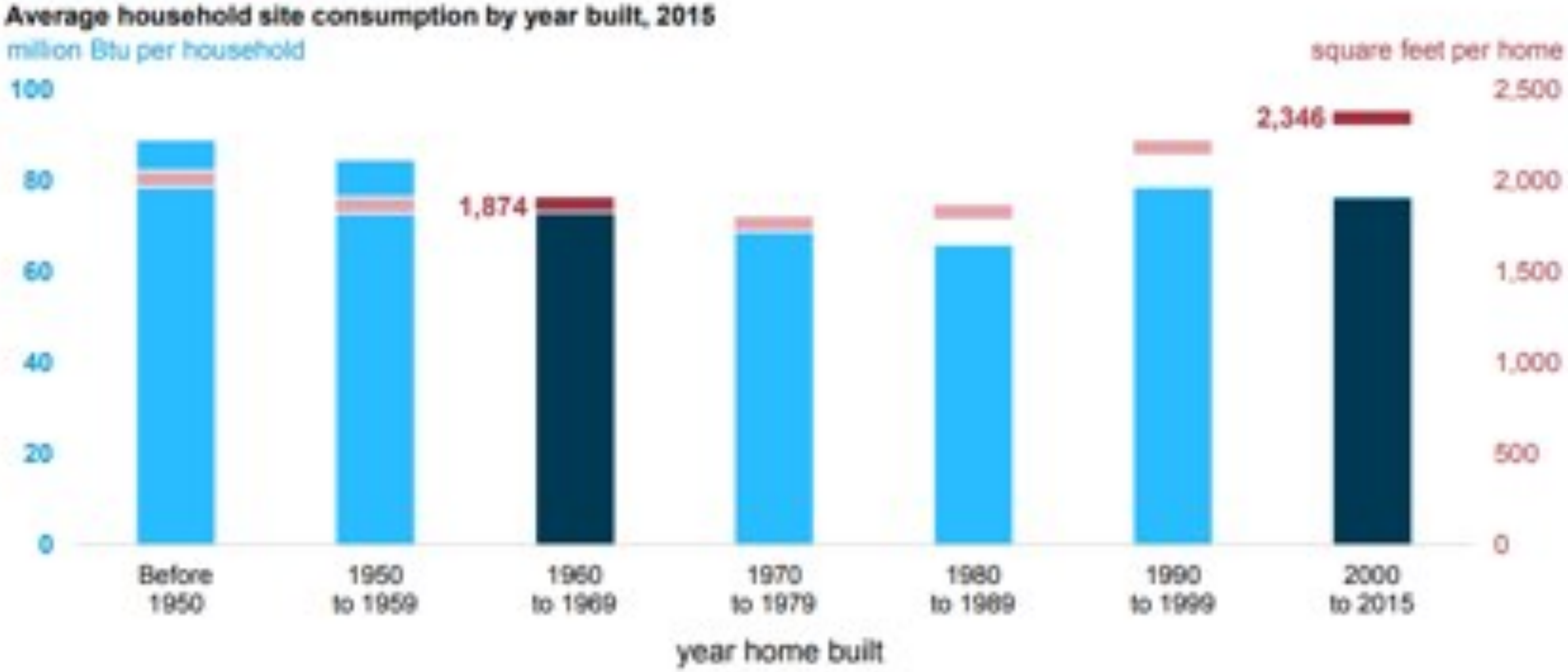
Data Source: U.S. Energy Information Administration (2012).



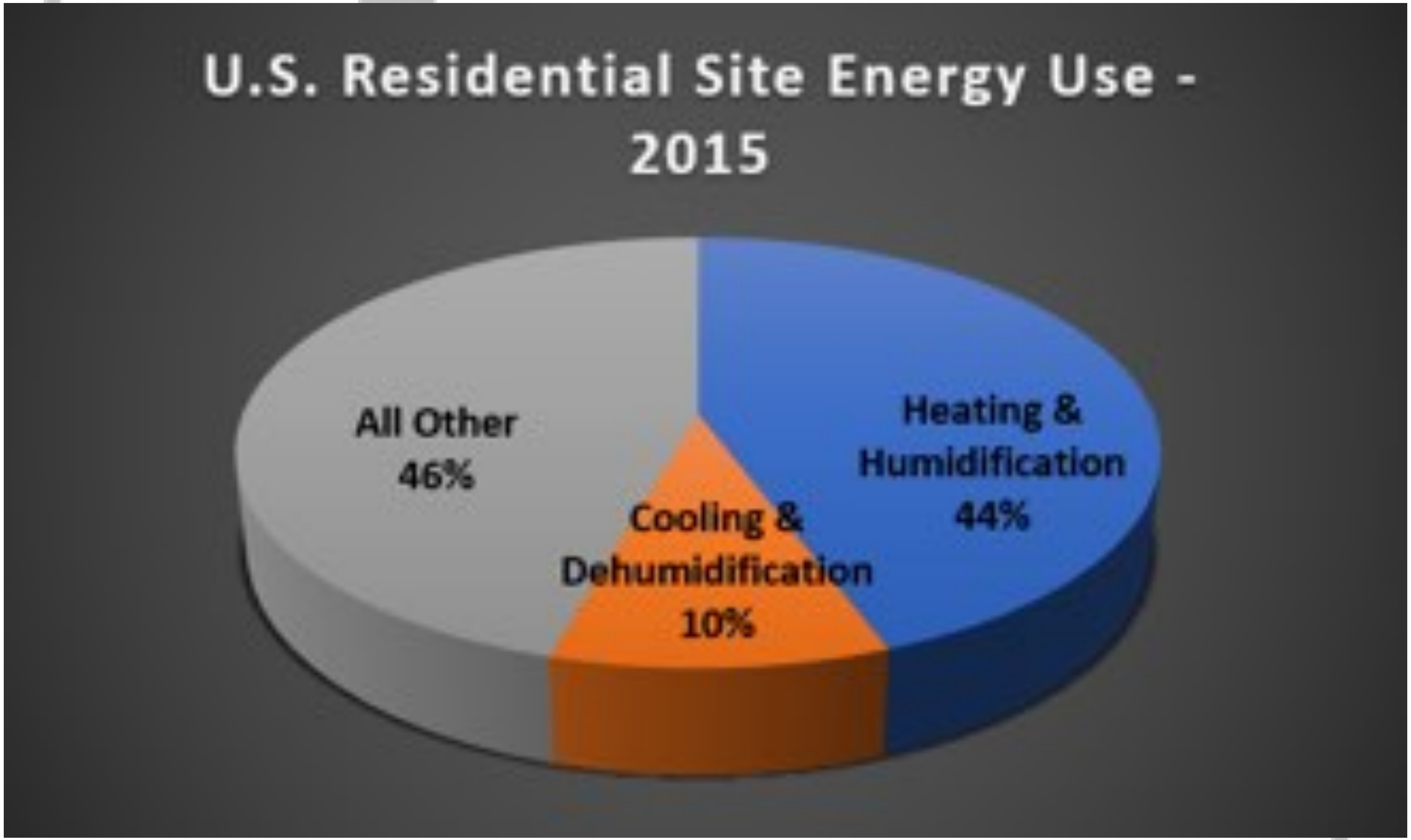
U.S. Energy Consumption by Sector

Source: ©2013 2030, Inc. / Architecture 2030. All Rights Reserved.
Data Source: U.S. Energy Information Administration (2012).

A home built since 2000 consumed the same amount of energy as one built in the 1960s



Source: EIA, 2015 Residential Energy Consumption Survey



Source: EIA, 2015 Residential Energy Consumption Survey

Architectural Solution: Enclosure First

Corvette Landing

Image: Peripheriques Martin-Trottin Architects

Enclosure First:

Passive House

Photo: SHED Architecture

AIA

Ethics

FROM THE OFFICE OF GENERAL COUNSEL

2018 Code of Ethics and Professional Conduct

Image: Holst Architecture

CANON VI

Obligations to the Environment

Members should recognize and acknowledge the professional responsibilities they have to promote sustainable design and development in the natural and built environments and to implement energy and resource conscious design.

AIA

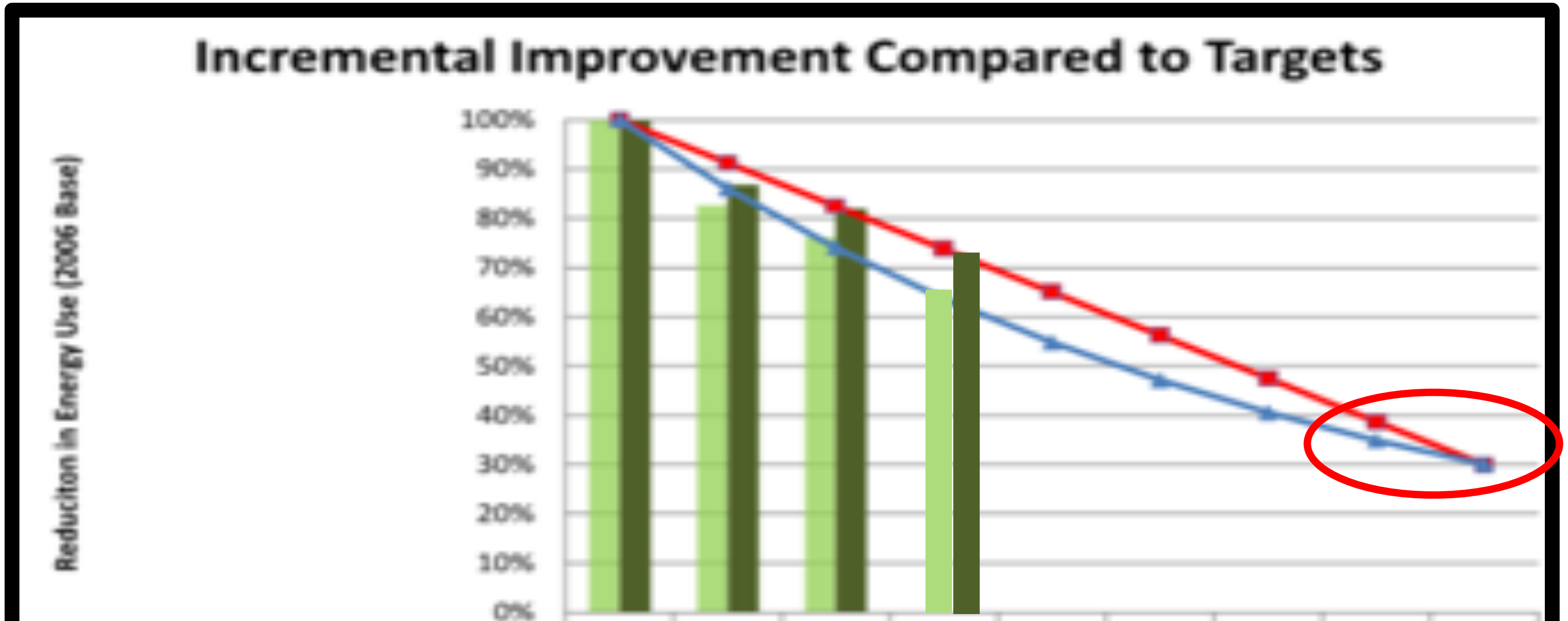
CANON VI

Obligations to the Environment

E.S. 6.1 Energy conservation: Members should set ambitious performance goals for greenhouse gas emission reduction with their clients for each project.

Image: Holst Architecture

Energy Code Roadmap: WA State



	2006	2009	2012	2015	2018	2021	2024	2027	2030
Residential	100%	82.7%	76.1%	69.0%					
Commercial	100%	86.8%	82.0%	75.0%					
Target: 8.75 % savings compared to the 2006 WSEC	100%	91%	83%	74%	65%	56%	48%	39%	30%
Target: 14% savings compared to each previous code	100%	86%	74%	64%	55%	47%	41%	35%	30%

Passive House as the goal

What is Passive House?

Passive House is a Toolkit

+

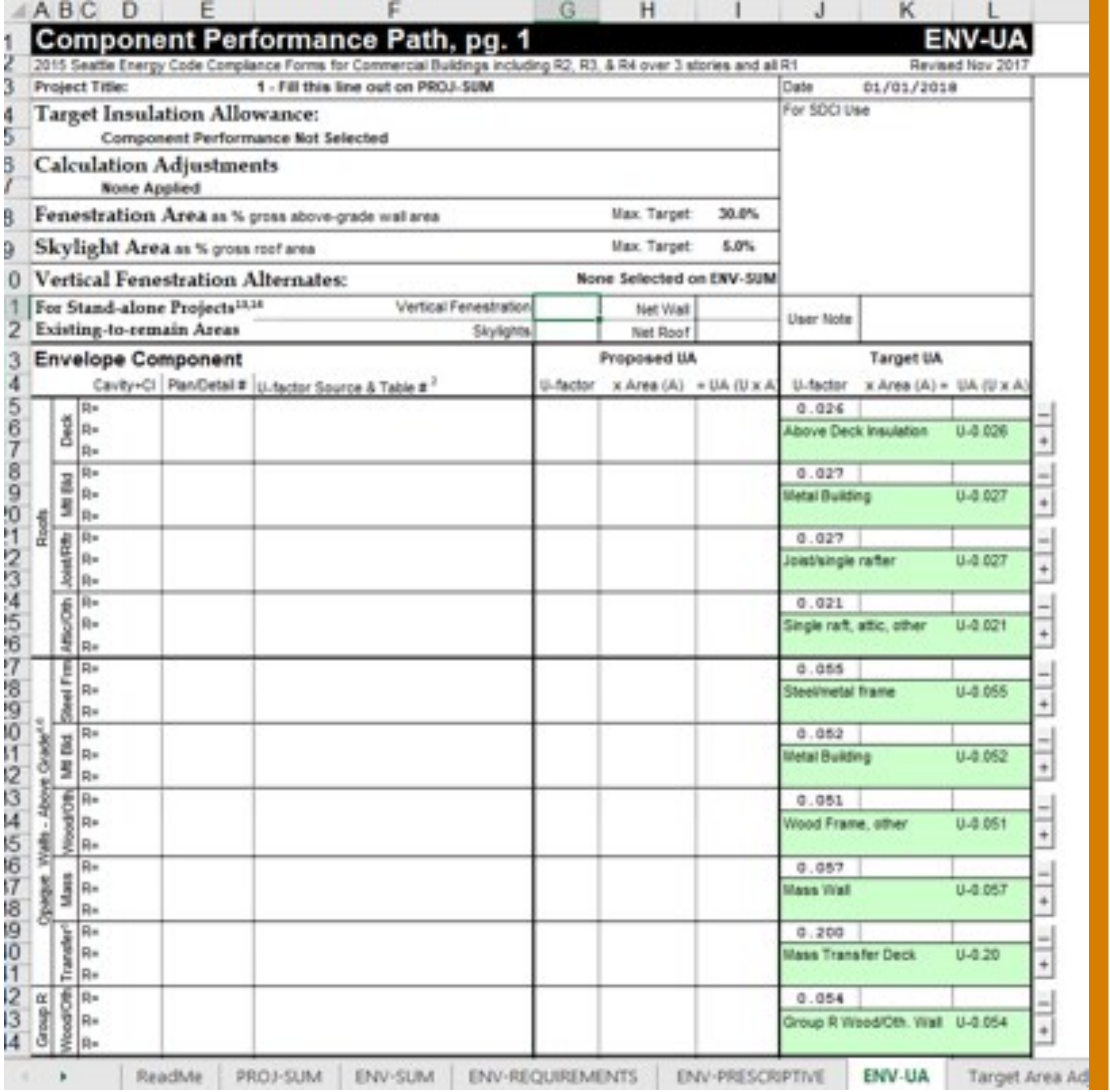
Passive House is a Path *with* Guardrails

Passive House is a Goal

Photo: Drew McKenzie, Sportspress Northwest

Energy Code has a Goal

- →Design a building using prescriptive assemblies
- →Figure out how much energy it will use
- →0%, 10%, 20% “better”



Passive House Delivers

Image: Holst Architecture

Engineered Energy Efficiency

Photo: Bicycle Homebuilding

Premium Indoor Air Quality

Premium Indoor Environmental Quality

Passive House: the Path to
-Net Zero Energy
-Zero Net Carbon

Photo: Onion Flats

Q: How much insulation do you need for a Passive House wall?

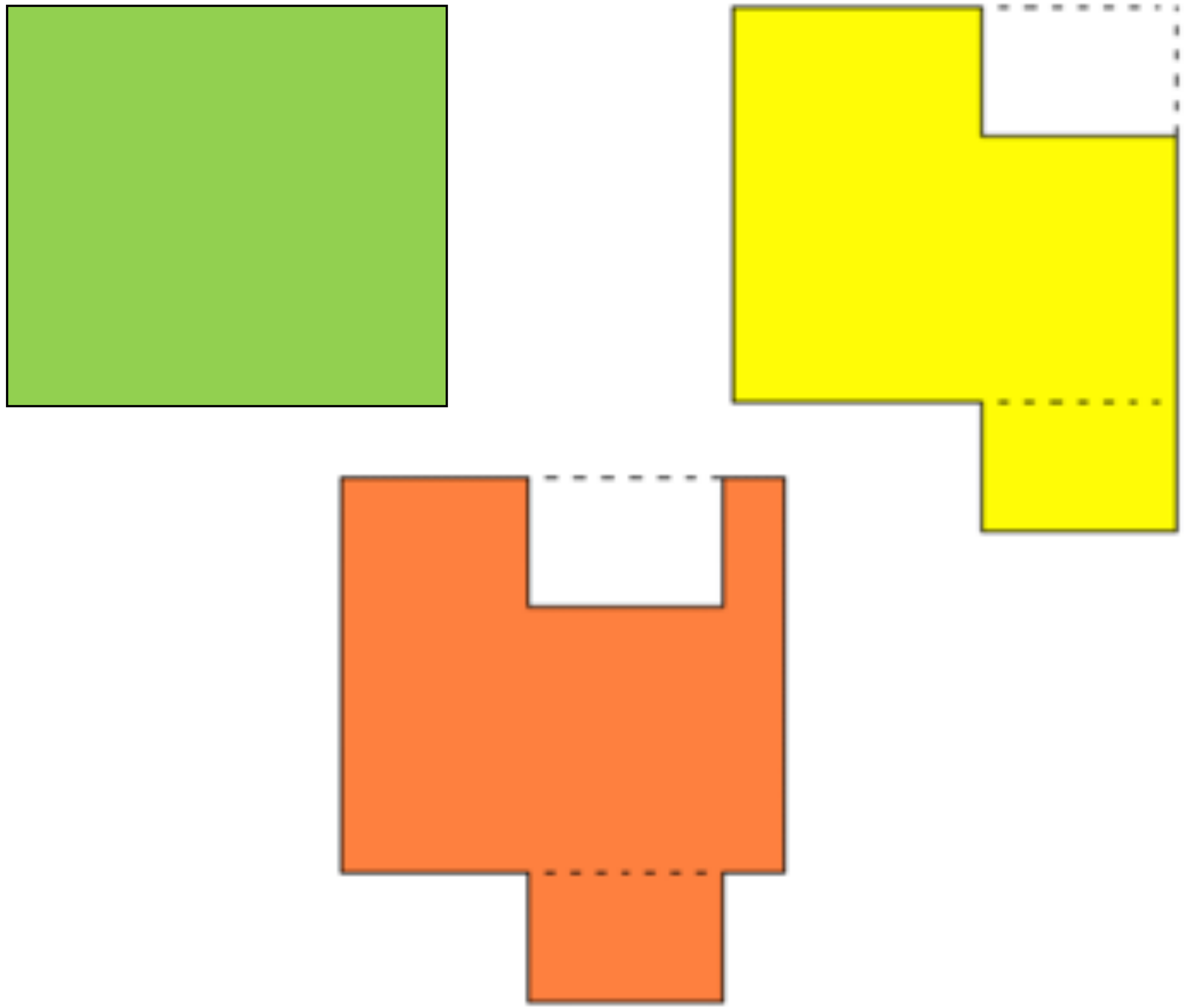
Q: How much insulation do you need for a Passive House wall?

A: As much as is required and no more

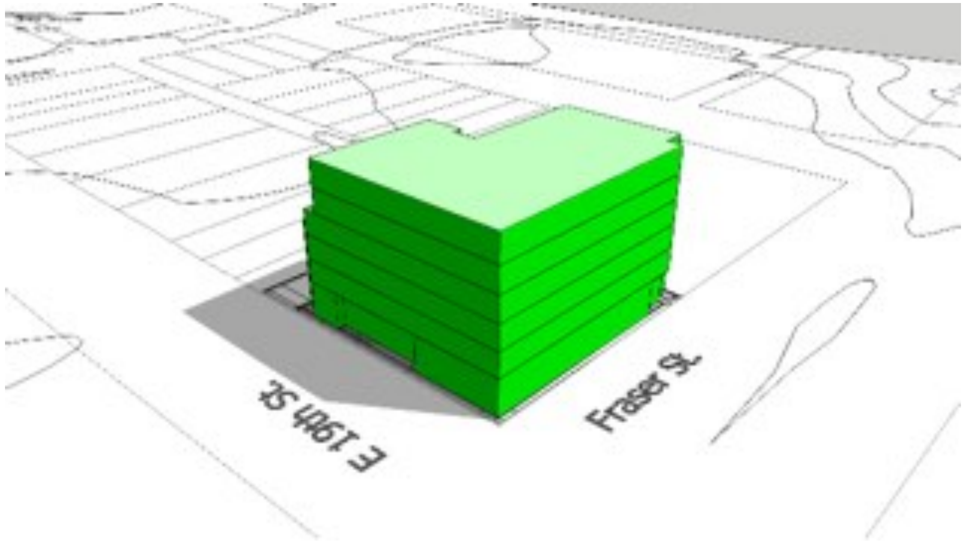
Enclosure to Usable Area Ratio

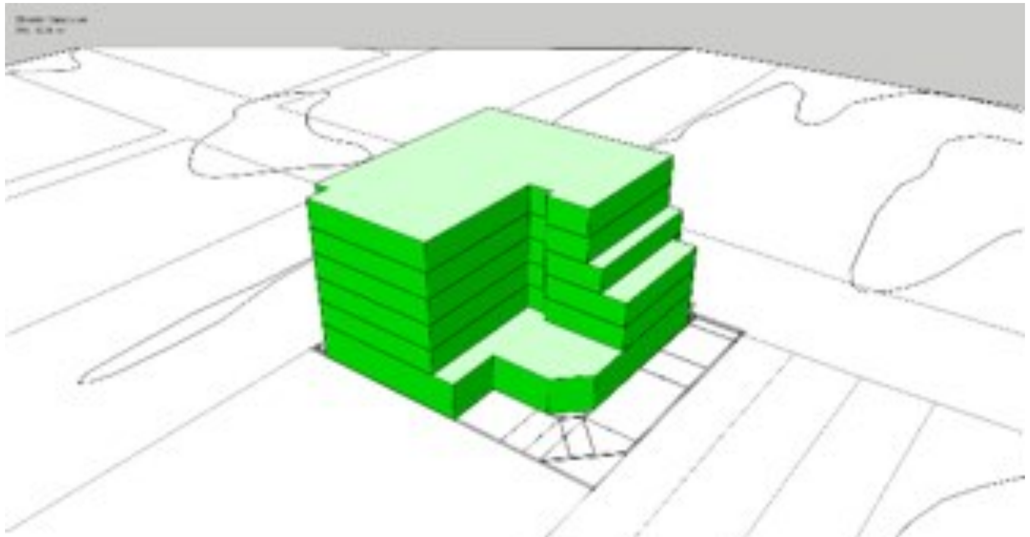

Photo: Vivian Usu

Building Form



Building Form



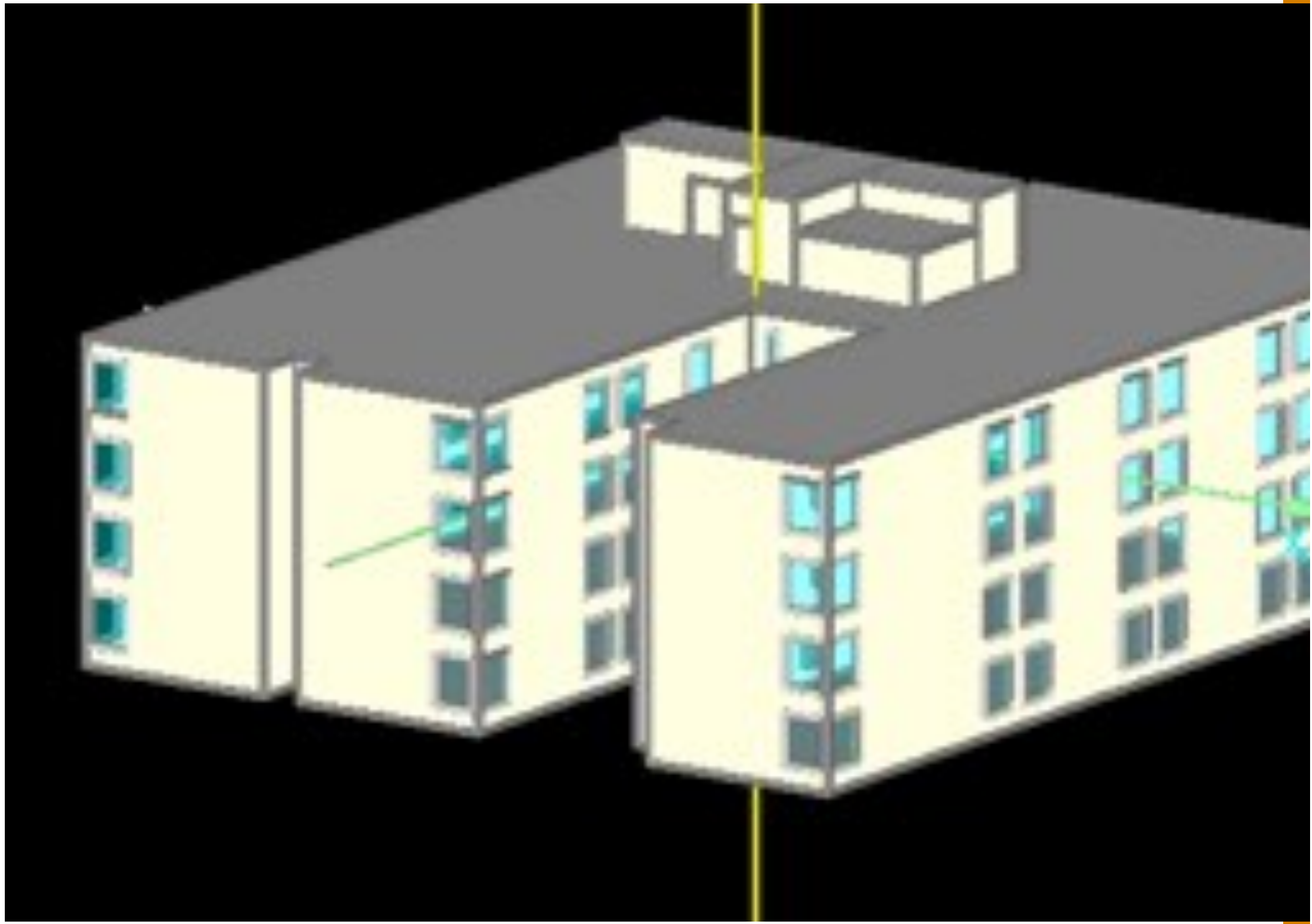


1:1 surface-floor ratio

Increase of 10%

Envelope Examples

- → Walls: $R\text{-}25_{eff}$
- → Roof: $R\text{-}43_{eff}$
- → Floor: $R\text{-}16$ to 30_{eff}
- → Windows: $U\text{-}0.24_{eff}$



Air Tightness: ***0.08*** cfm/ft2 75Pa*

Envelope Examples

→Walls: R-38$_{eff}$

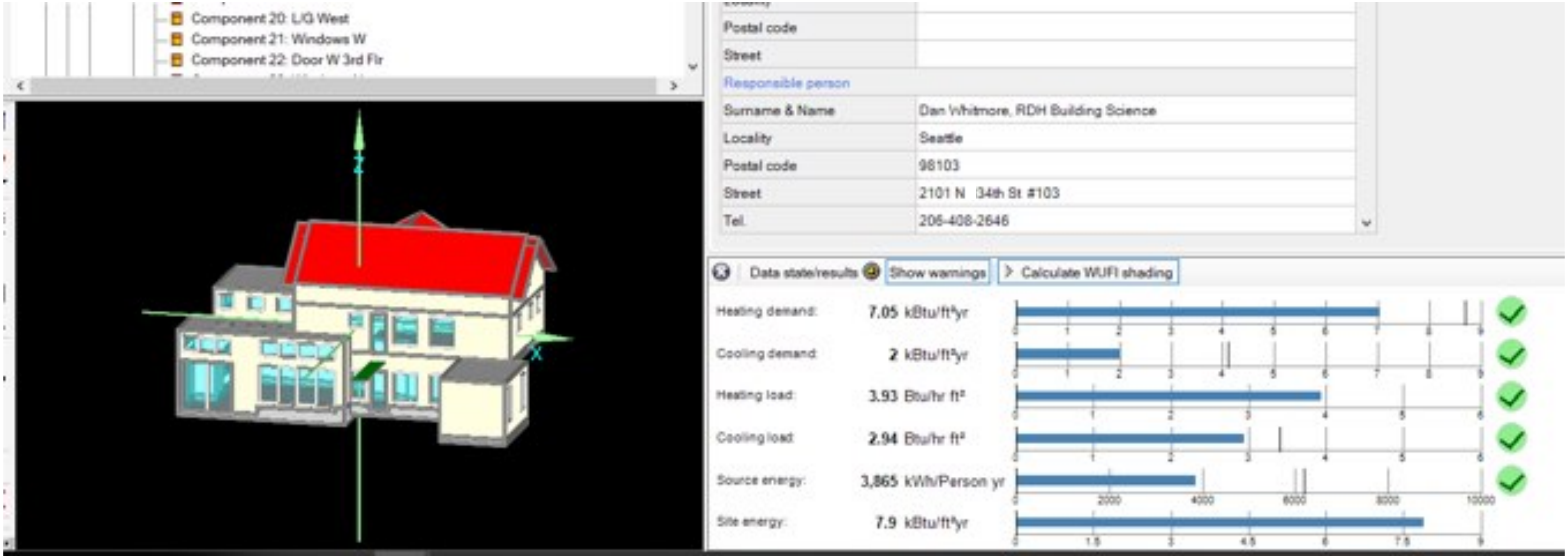
→Roof: R-67$_{eff}$

→Floor: R-24 to 45$_{eff}$

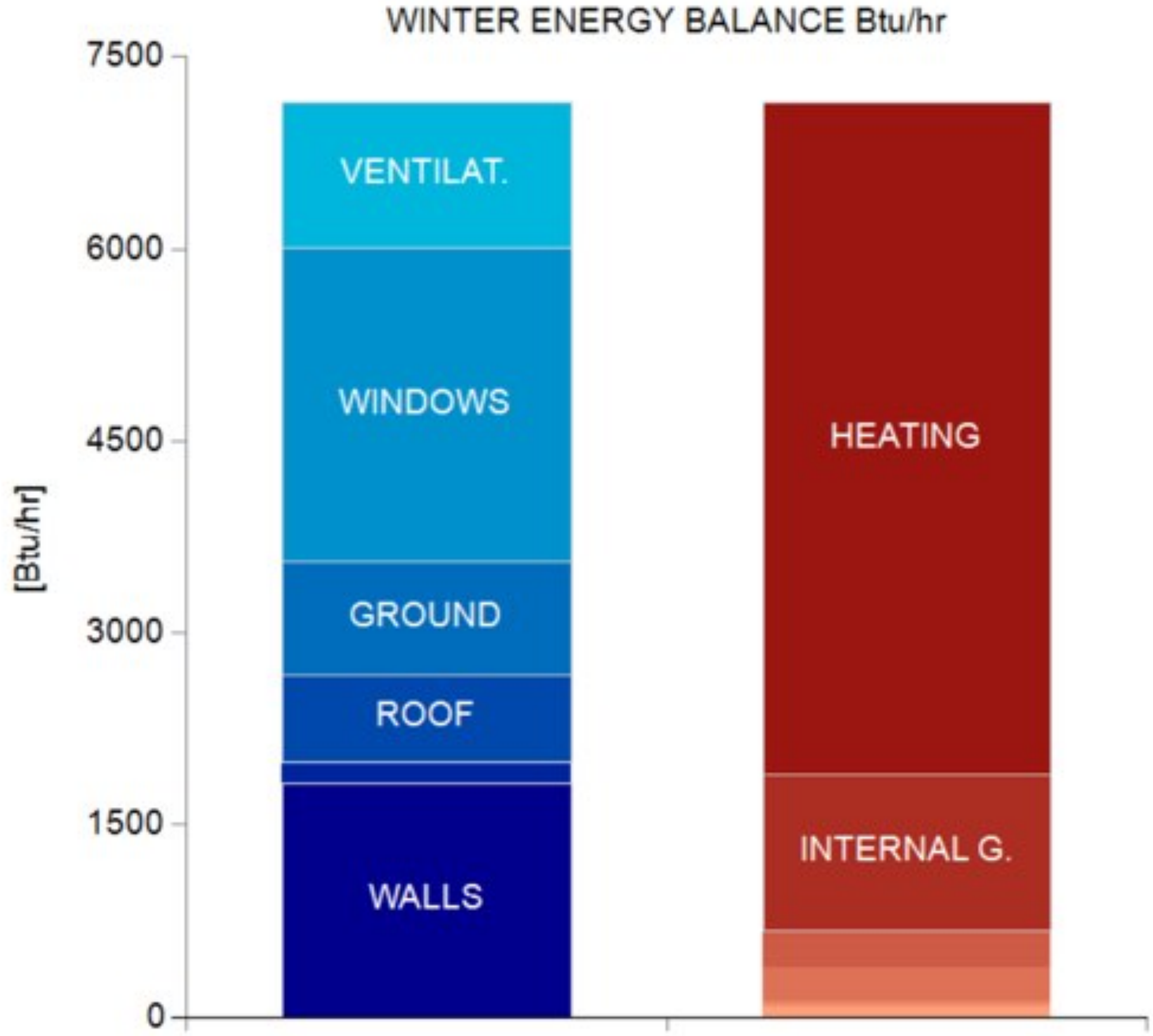
→Windows: U-0.15$_{eff}$

Air Tightness:

0.08 cfm/ft2 75Pa*



Passive House: Engineered Energy Performance



Passive House Enclosure Mantra:

1. Super-Insulated
2. Thermal Bridge "Free"
3. Air-Tight

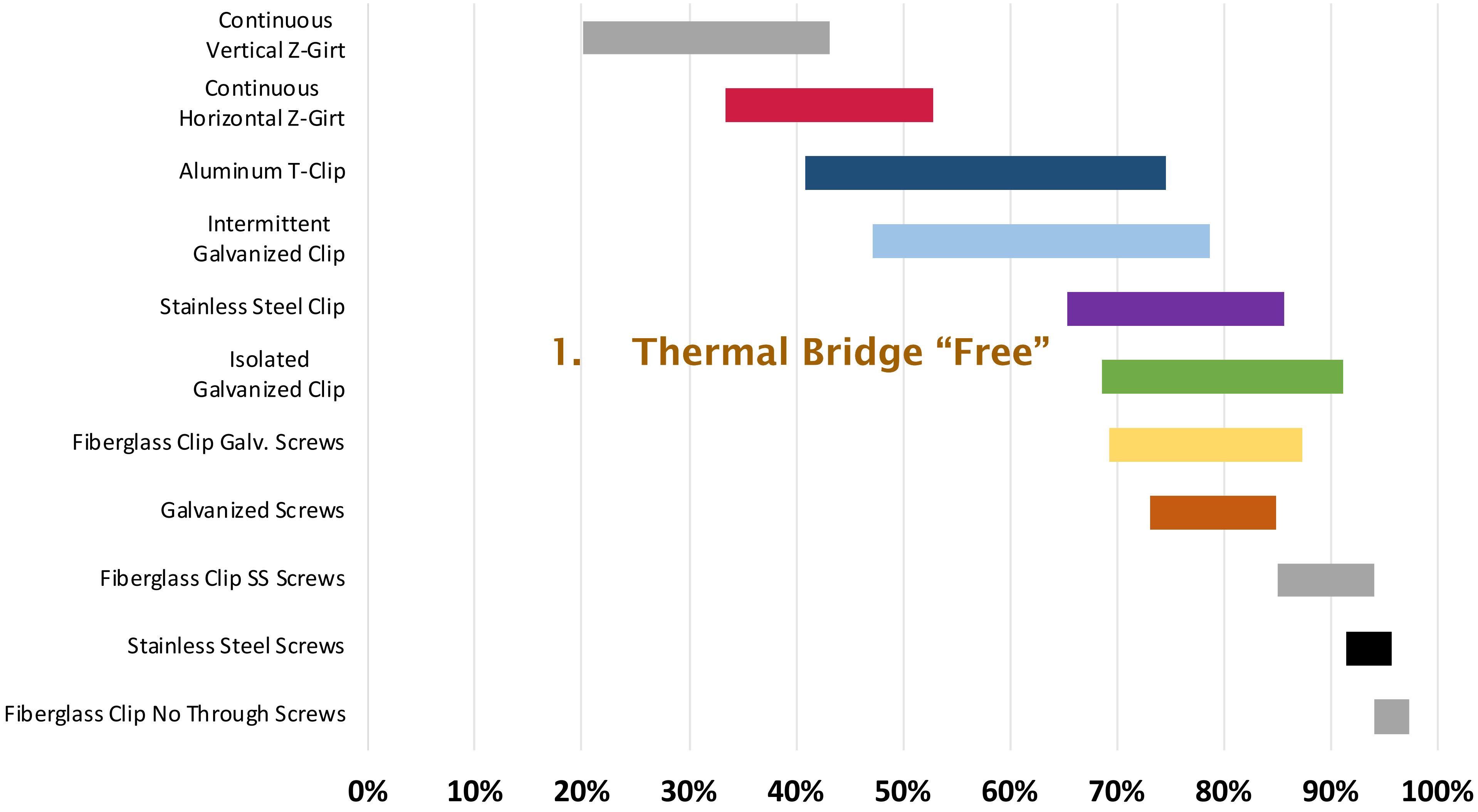
1. Super-Insulated

super adjective

su·per | \ˈsü-pər \

Definition of *super* : of high grade or quality

Effective R-Value due to Exterior Insulation Attachments

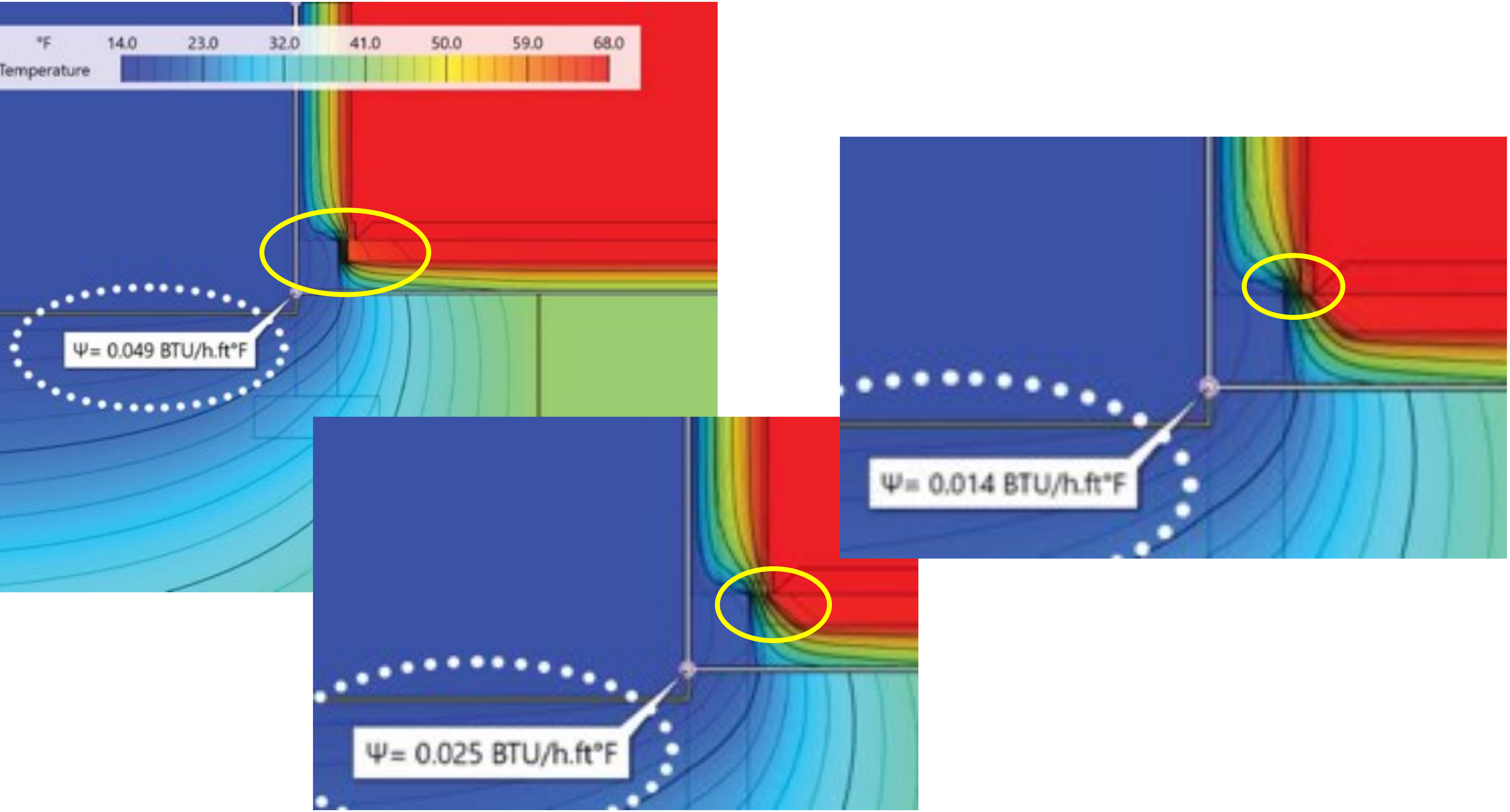


<u>Effective</u> R-Value

[redacted]

2. Thermal Bridge “Free”

Photo: Walsh Const.

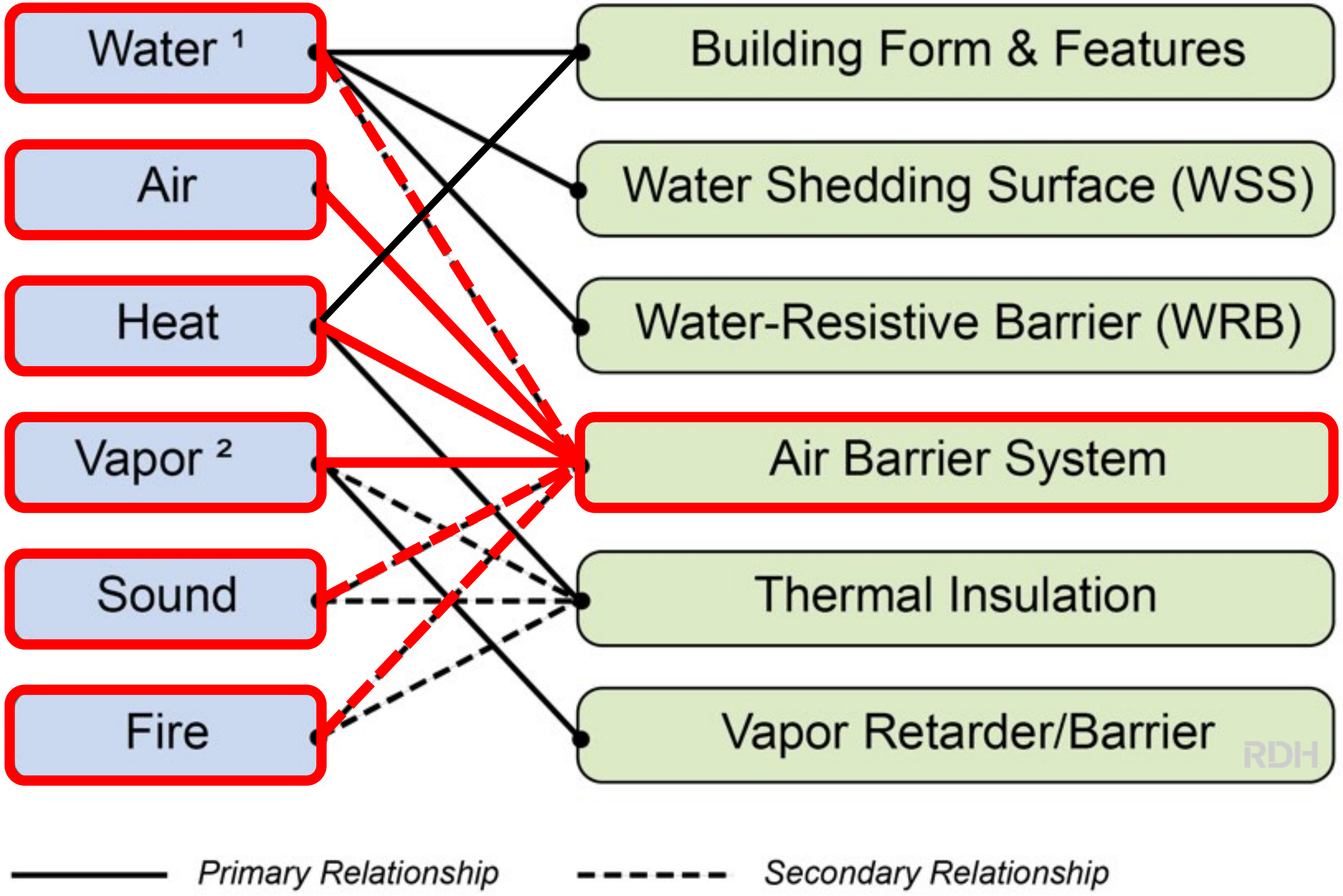


°F 14.0 23.0 32.0 41.0 50.0 59.0 68.0
Temperature
Ψ= 0.049 BTU/h.ft°F
Ψ= 0.025 BTU/h.ft°F
Ψ= 0.014 BTU/h.ft°F

3. Air-Tight

Photo: REACH CDC

Why the Air Barrier is so important

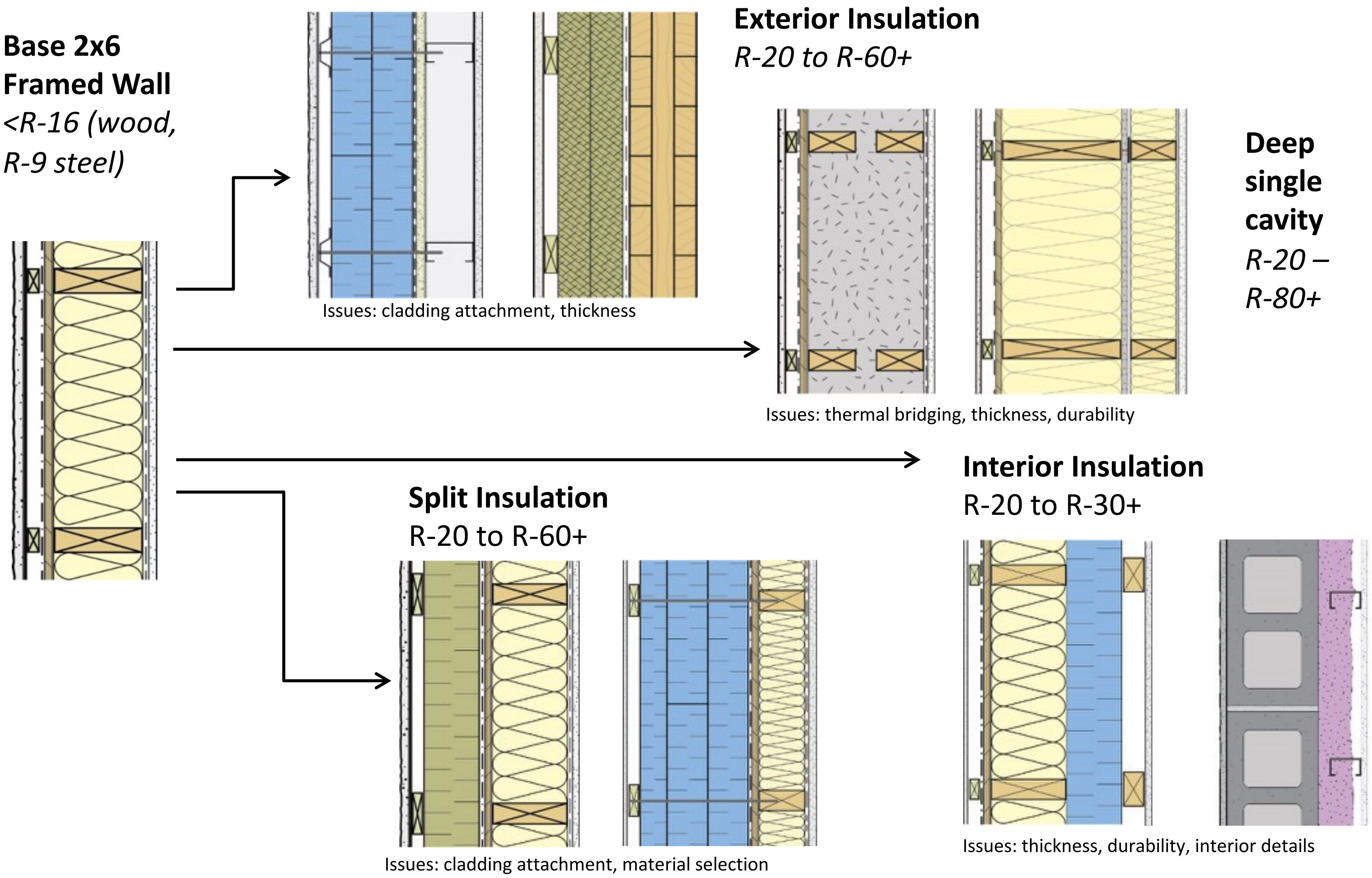


1 – Water is defined here as precipitation (rain, snow, hail, etc.) and ground water
2 – Vapor is separately defined here as the water vapor in air, as well as condensate moisture

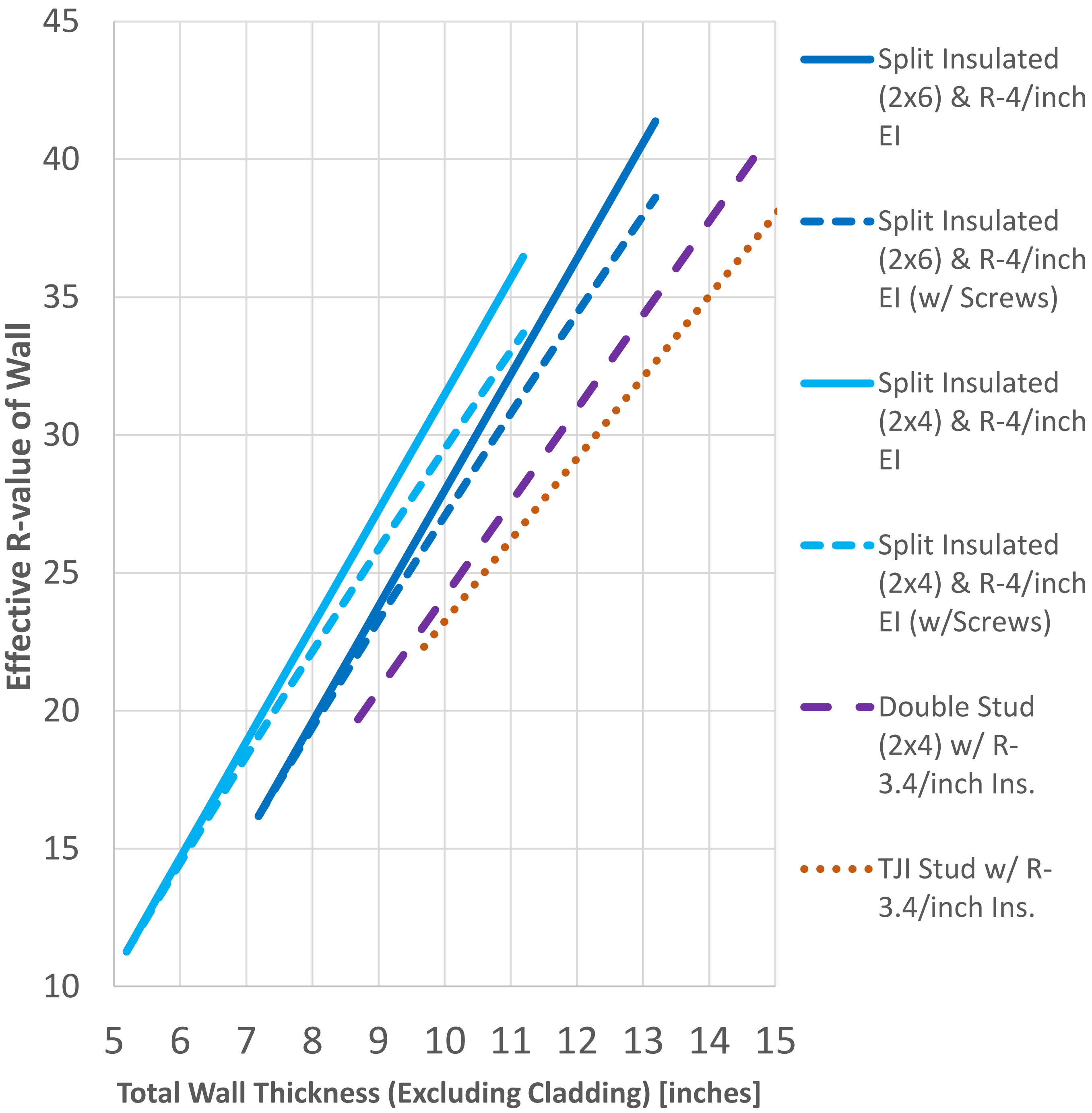
Delivering Passive House Enclosures

Photo: REACH CDC

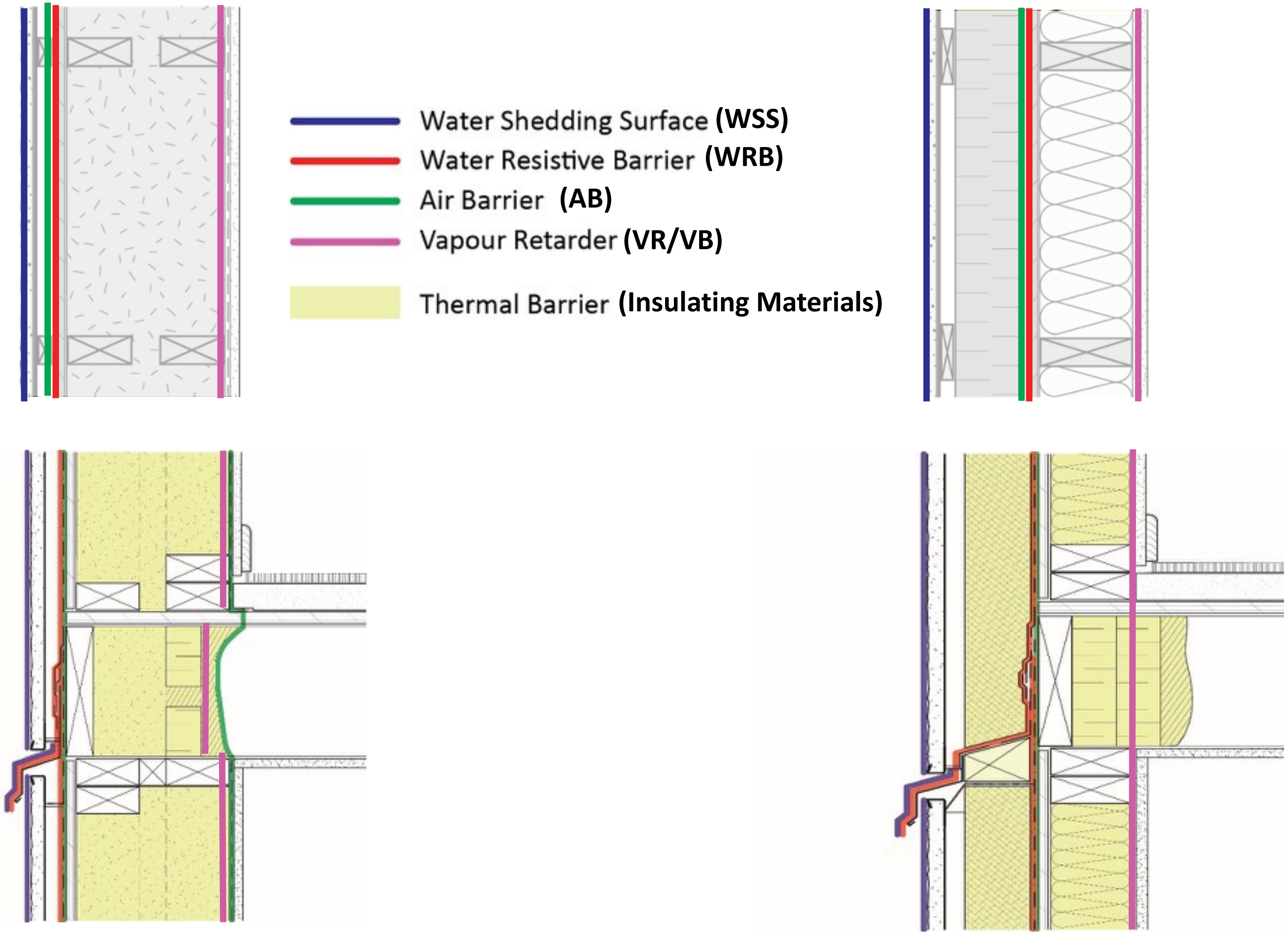
Delivery is in the Details



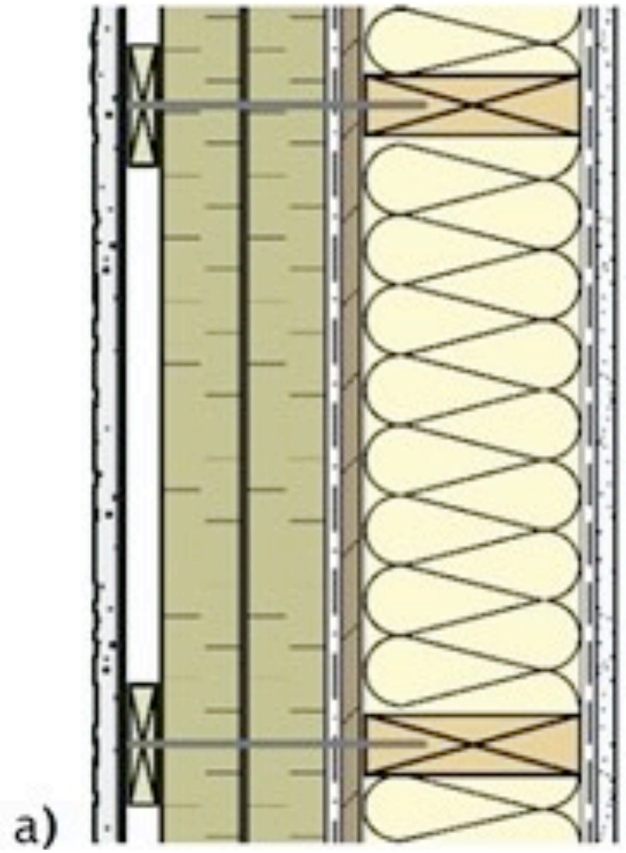
Effective Wall R-value versus Wall Thickness



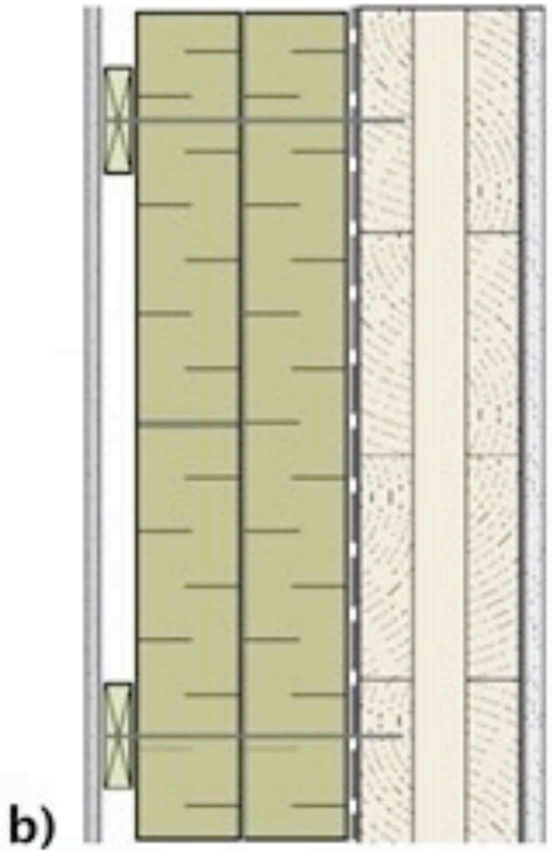
Enclosure: Critical Barrier Analysis of Super Insulated Walls



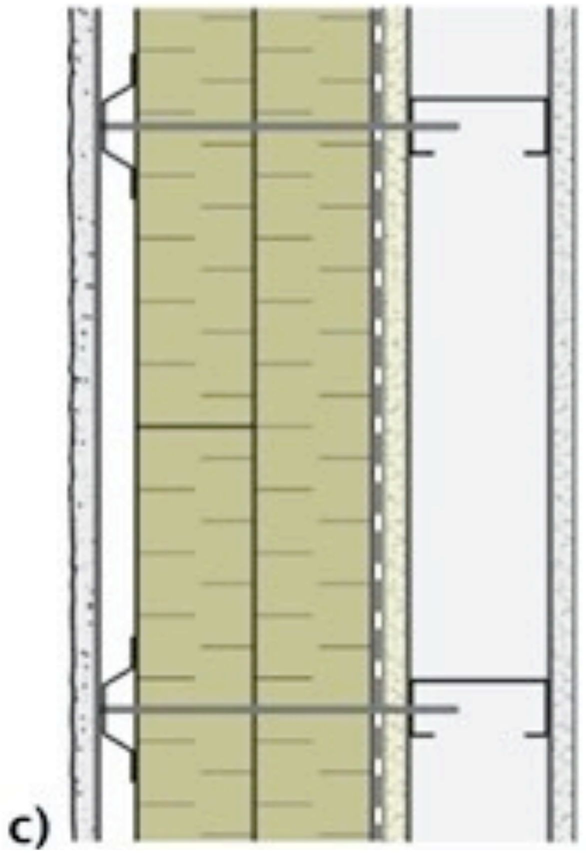
Exterior Insulation over common wall types: the field is easy



Wood Frame

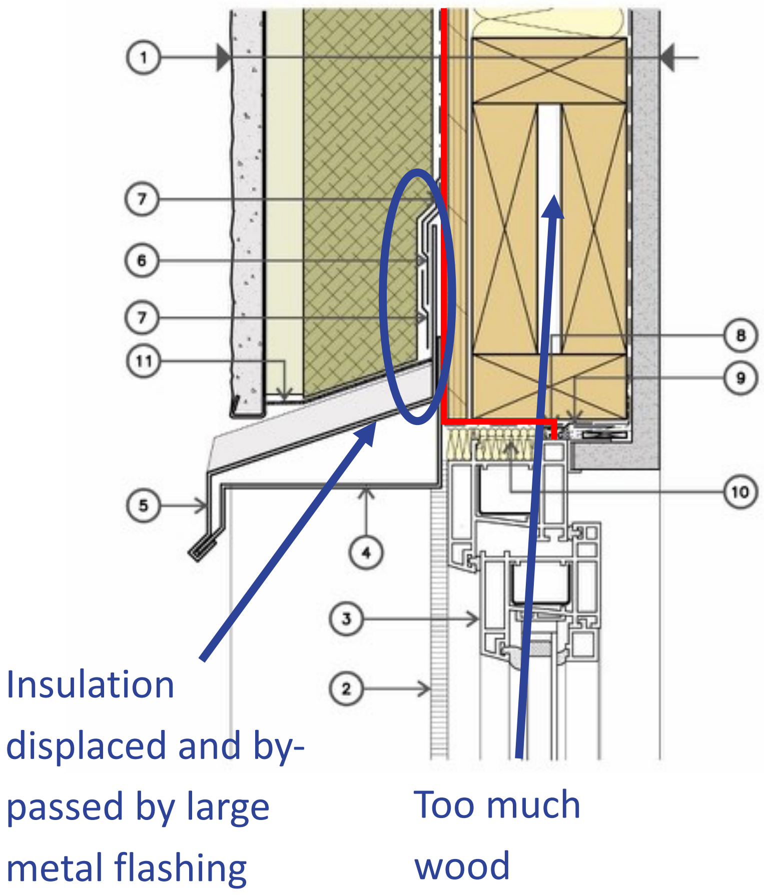


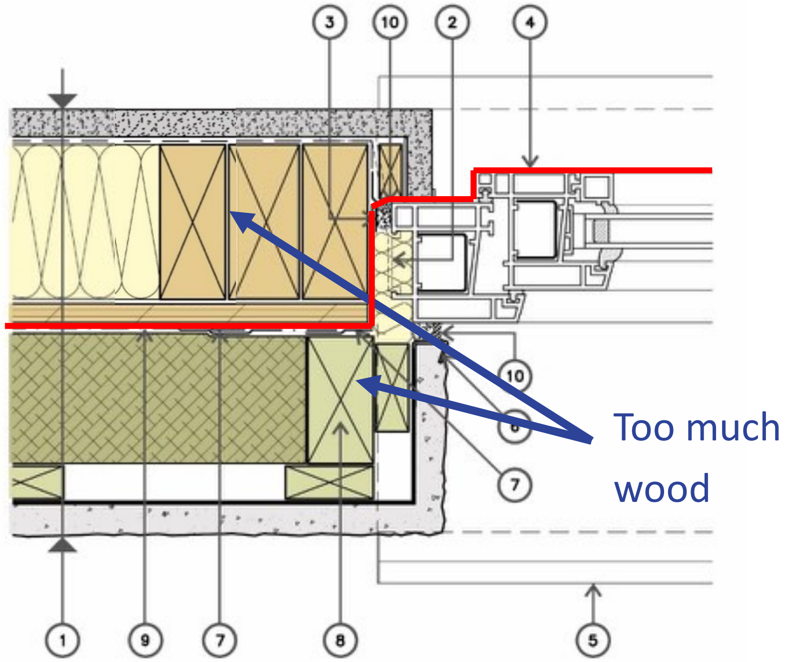
Cross-Laminated Timber



Steel Frame

Window Installation Details are not as easy

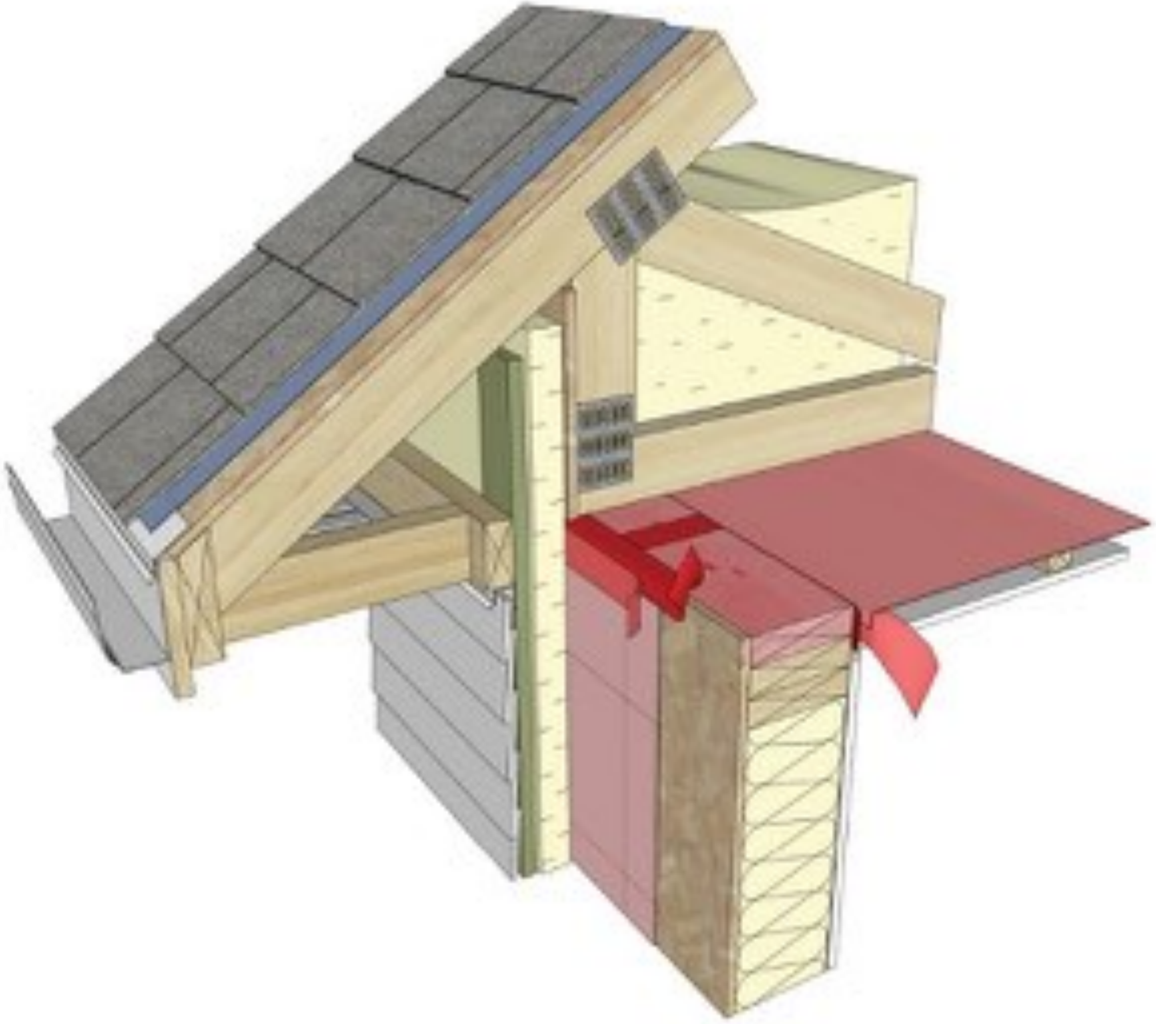




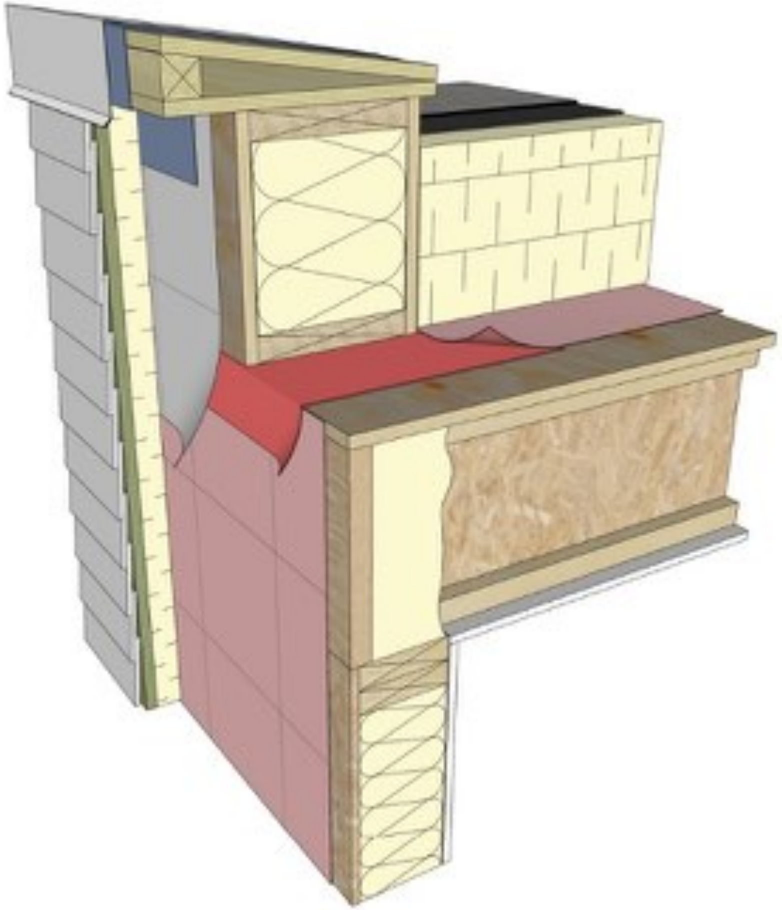
Key considerations:

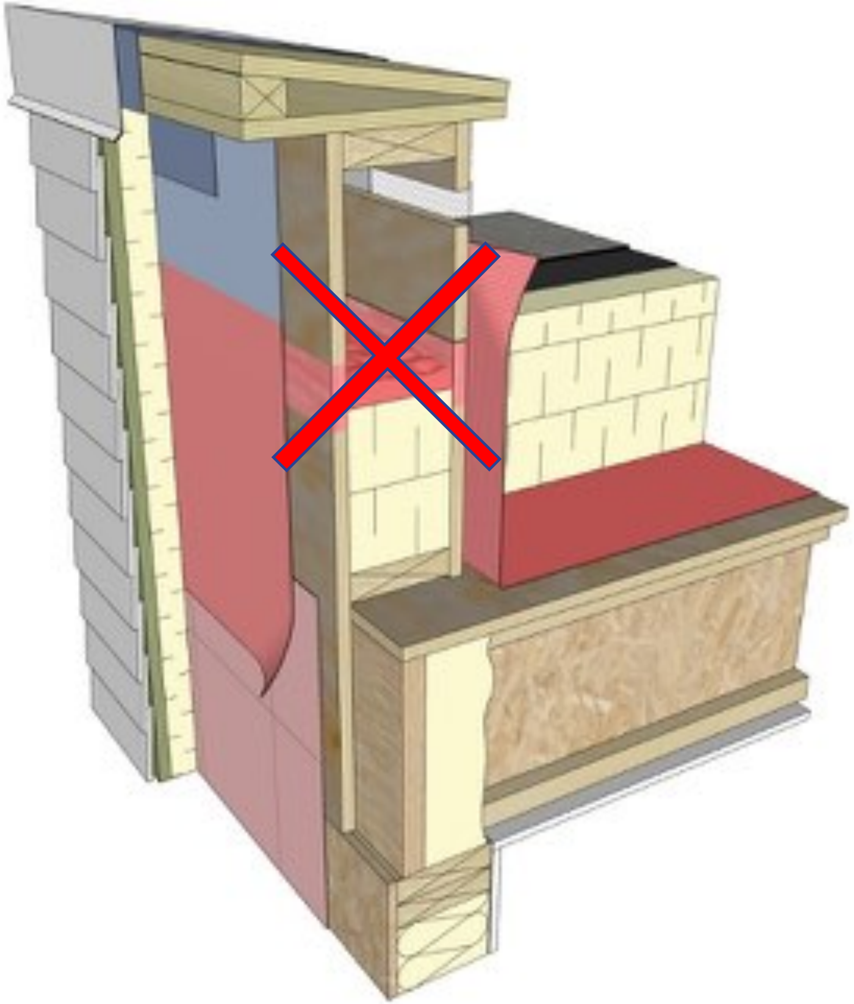
- **Avoid metal flashings that bypass framing or insulation**
- **Reduce wood framing around window**
- **Over-insulate the window frames where feasible**
- **Air tight**
- **Proper water management**

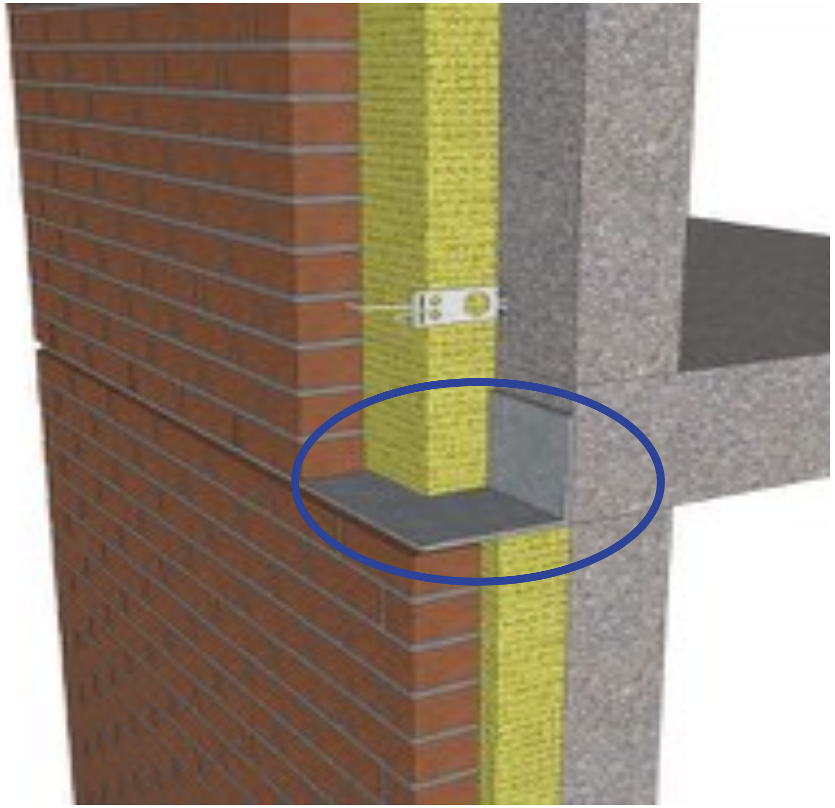
Air Barrier Challenges @ Transitions



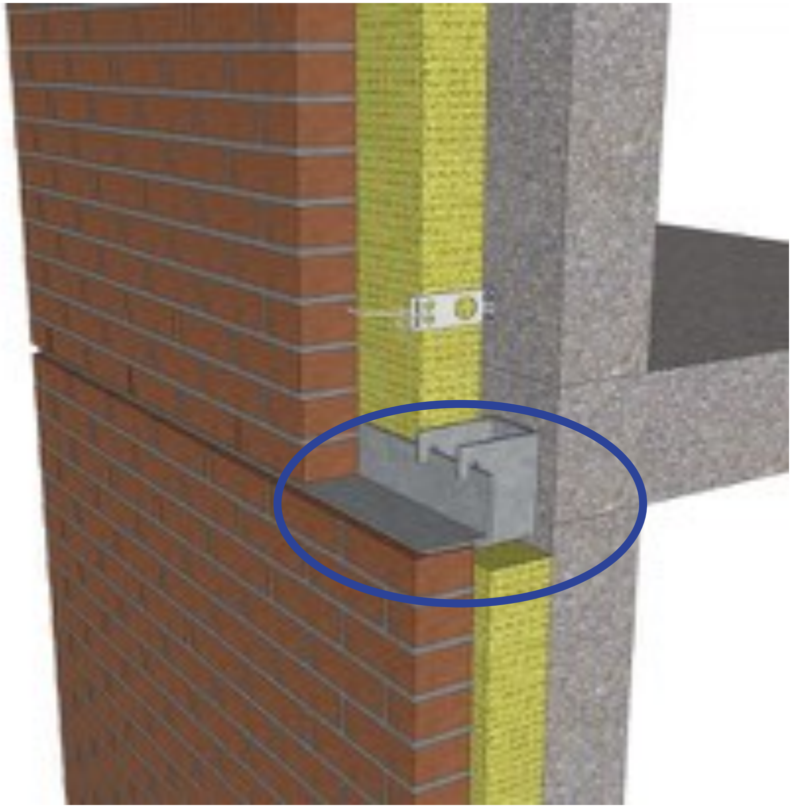
Air Sealing at Parapets



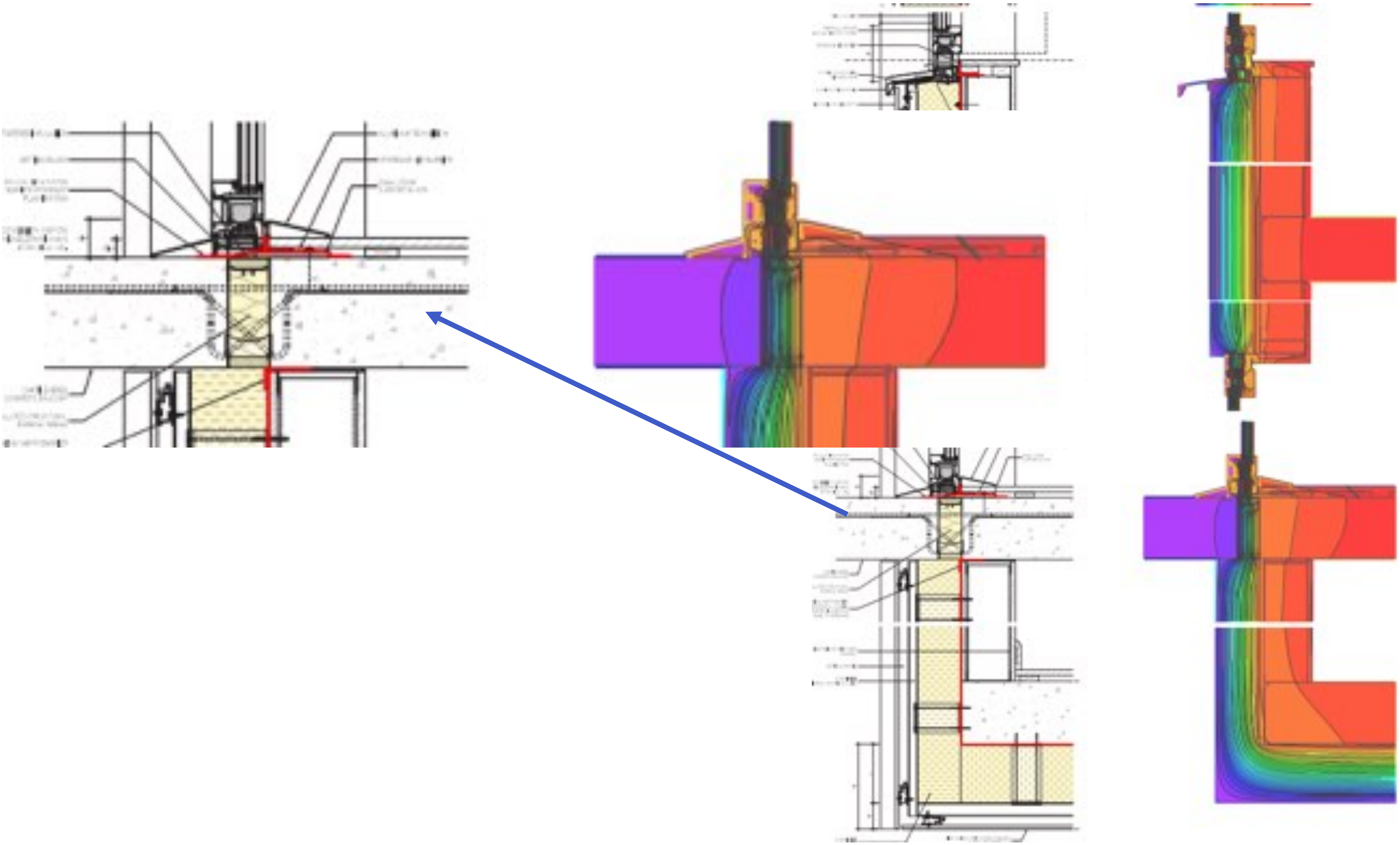


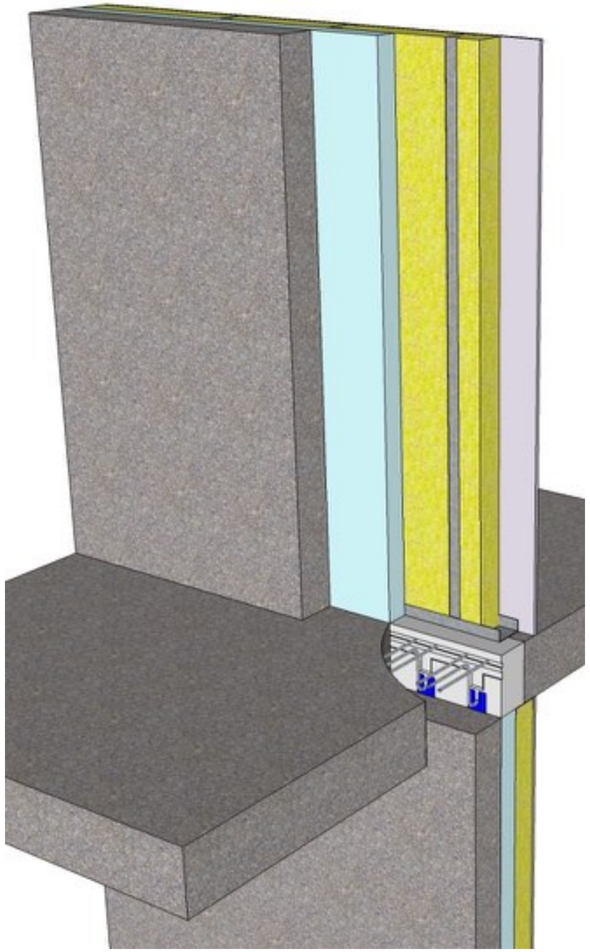


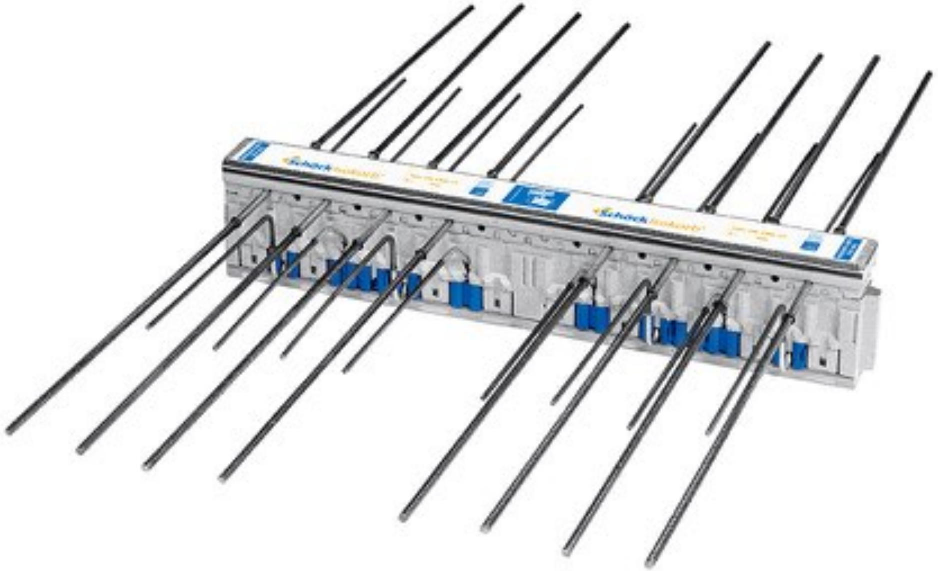
Continuous shelf angles
~50% R-value loss



Shelf angle on stand-offs
only ~15% R-value loss

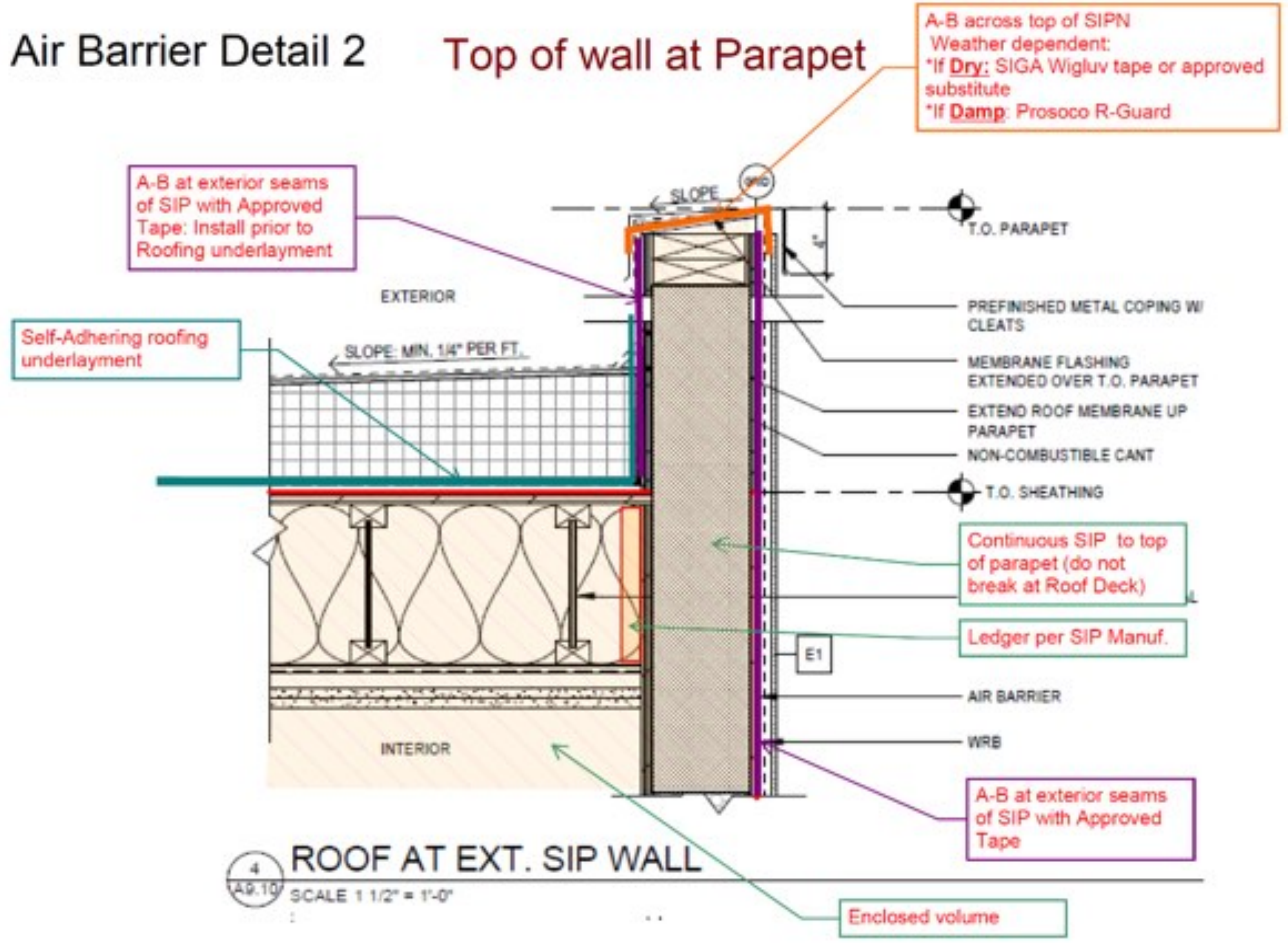






Delivery is in the Details: Installer Review

Delivery is in the Details: Installer Review



Courtland Place Passive House

2011

Seattle, WA

Karuna Passive House

2014 Yamhill County, OR

Holst Architects

Hammer and Hand

Photo

Wallingford Passive

2016 Seattle, WA

Whitney Architecture

Hammer and Hand

Madrona Passive House

2015 Seattle, WA

SHED Architecture & Design

Hammer and Hand

Flora Vista Passive House

2018 Olympia, WA

Roussa Cassel, Architect

Bicycle Homebuilding

Pax Futura

2018 Seattle, WA

NK Architects

Cascade Built

Pax Futura

2018 Seattle, WA

NK Architects

Cascade Built

Photo: Vivian Usu

ORCHARDS AT ORENCO Phase I
Hillsboro, OR

2016

REACH CDC

Ankron-Moison Architecture

Walsh Construction

Photo: REACH CDC

DOIG RIVER CHURCH

Ft Saint John
British Columbia
2019

THE HEIGHTS

85-unit market-rate rental
Vancouver, BC
2017
8th Avenue Development
Cornerstone Architecture
Peak Construction Group

BRECHIN REDEVELOPMENT

Nanaimo

Church & 74 rental apts
VIA Architecture

SKEENA DORM

Six stories, 220 rooms
UBC Okanagan

UBC Properties Trust
Public Architecture

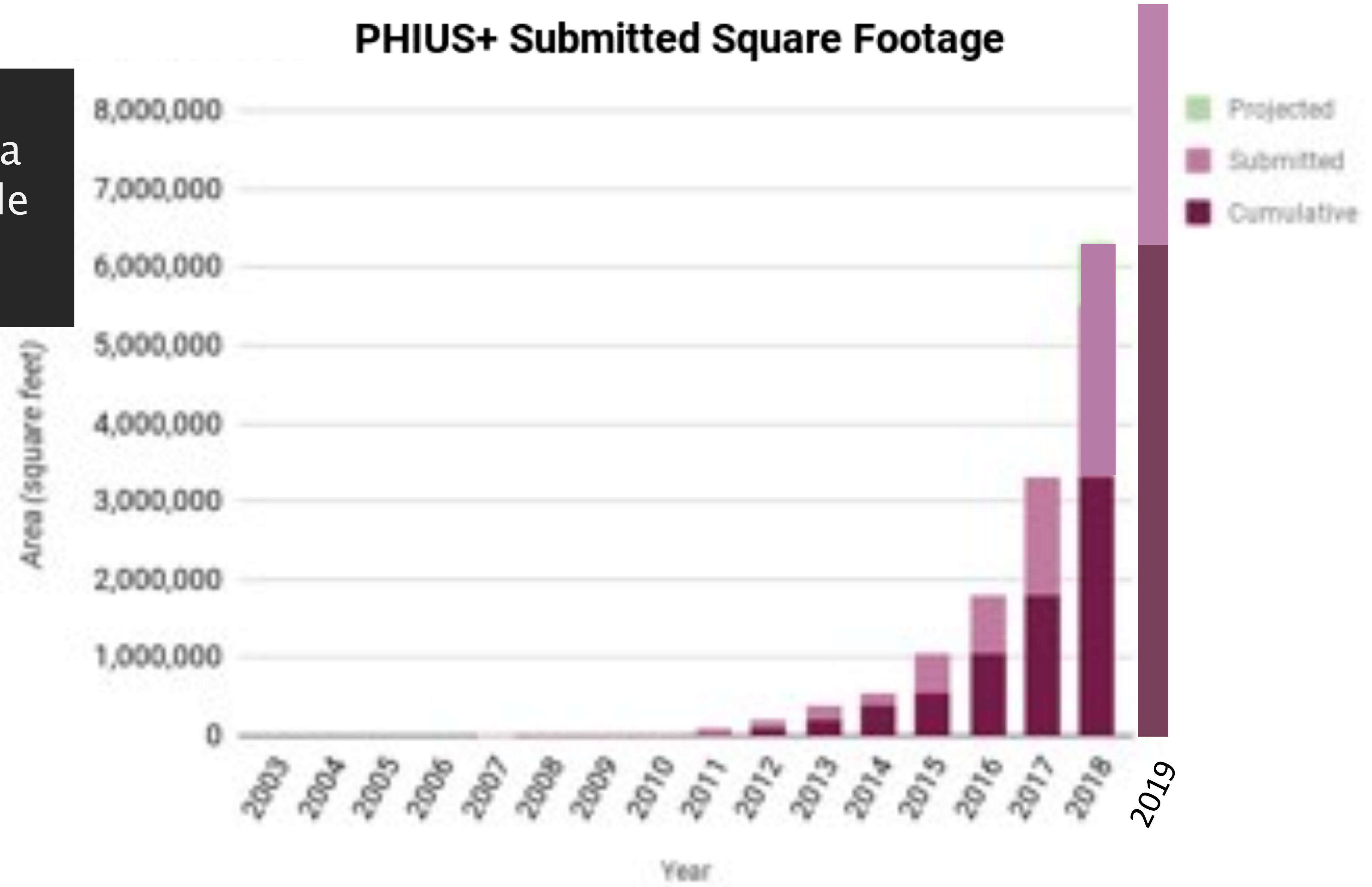
Photos: RMI

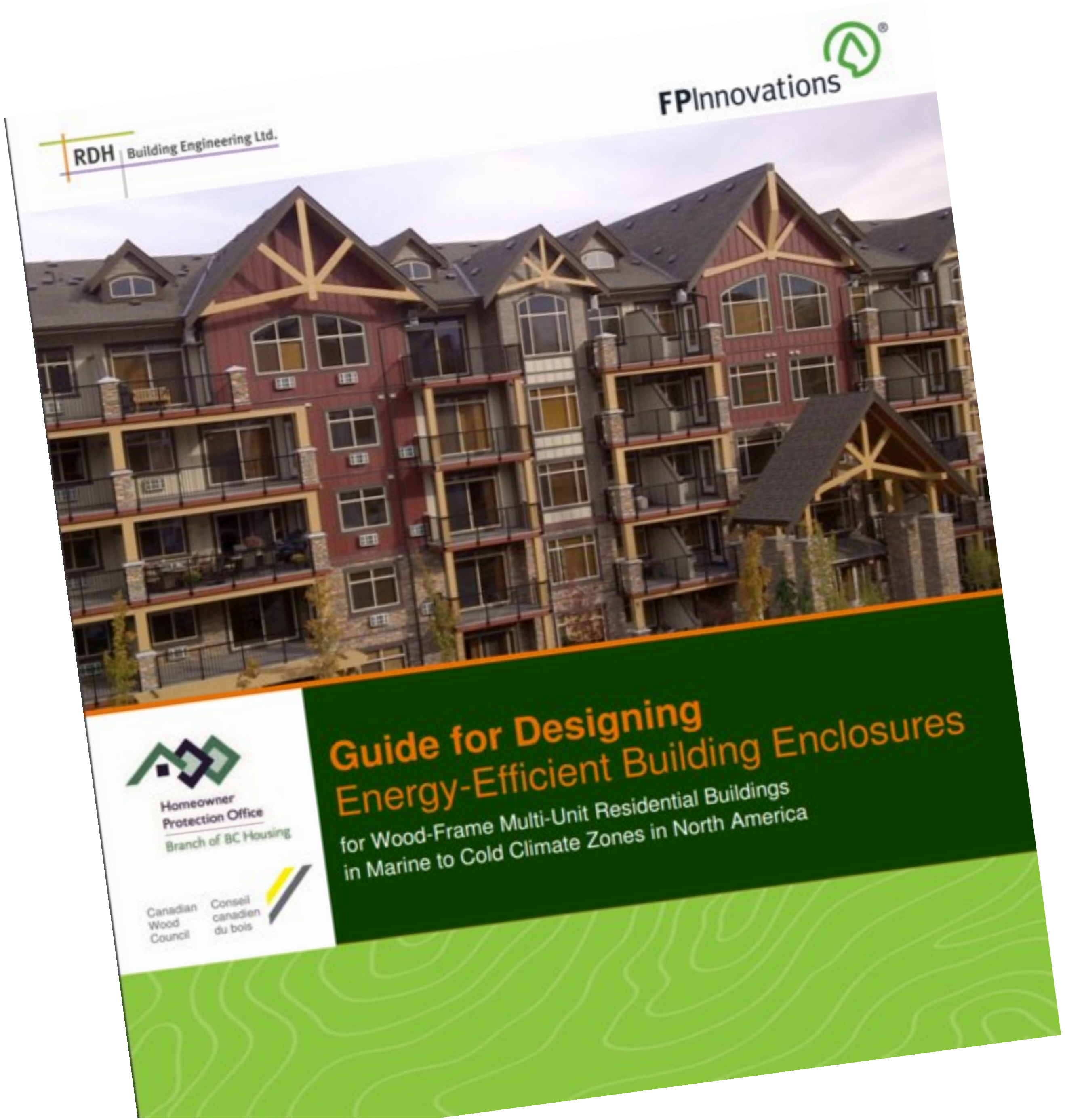
ROCKY MOUNTAIN INSTITUTE

Basalt, CO

2017

Passive House is a Achievable *and* Scalable




FPInnovations
RDH Building Engineering Ltd.
Guide for Designing
Energy-Efficient Building Enclosures
for Wood-Frame Multi-Unit Residential Buildings
in Marine to Cold Climate Zones in North America
Homeowner Protection Office
Branch of BC Housing
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ILLUSTRATED GUIDE
Achieving Airtight Buildings
This guide provides information for design and construction professionals to assist in designing, constructing, and testing airtight Part 3 and larger more complex Part 9 residential buildings in British Columbia
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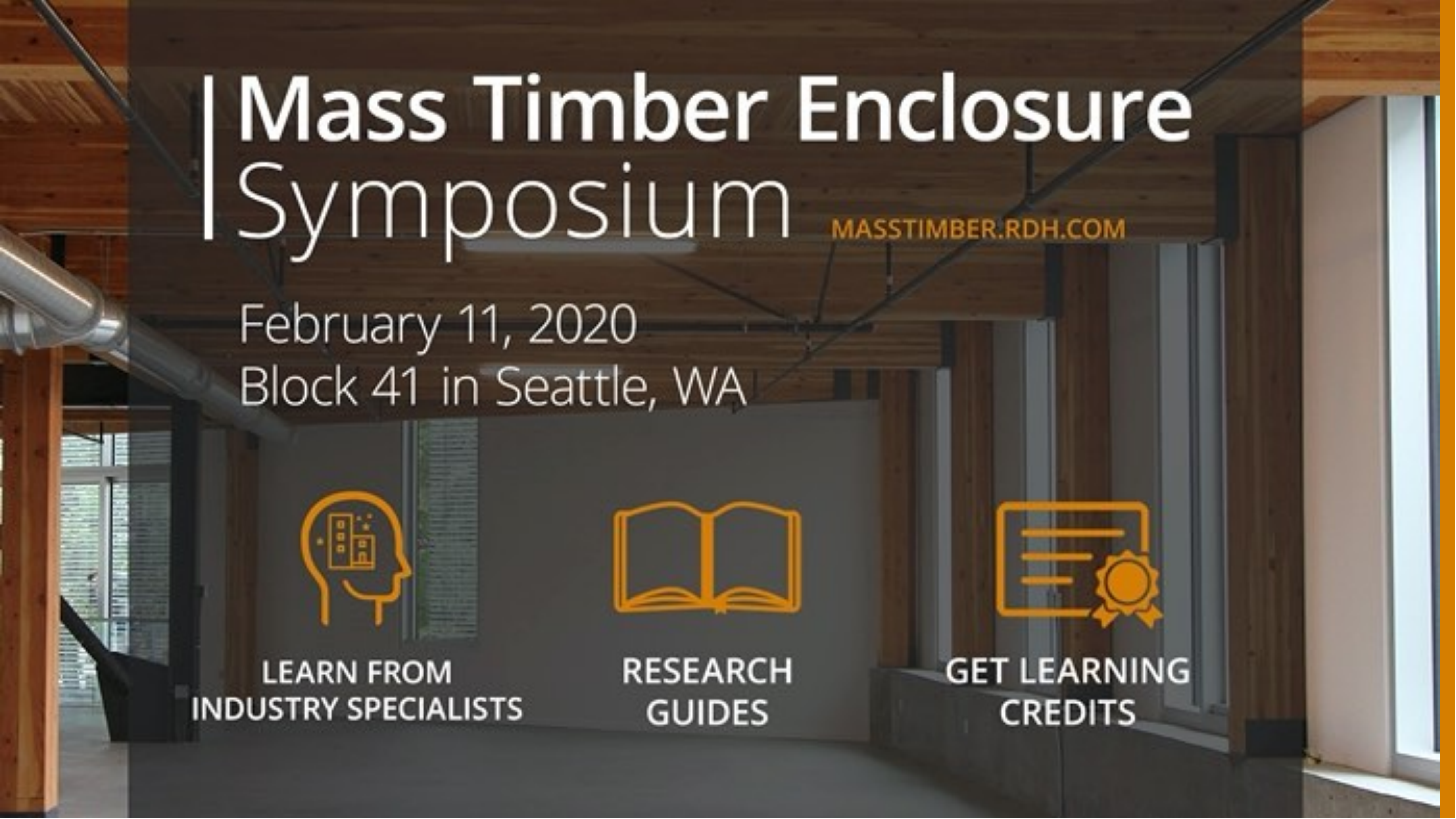
+ James Higgins, AScT

2018



Mass Timber Enclosure
Symposium
MASSTIMBER.RDH.COM
February 11, 2020
Block 41 in Seattle, WA
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Thank You

Photo: Thorsten Chlupp
Karuna Foundation

Dan Whitmore- CPHC, CPHB
dwhitmore@rdh.com

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

Dan Whitmore

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